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(54) Title: MAMMALIAN EPO MIMETIC CH1 DELETED MIMETIBODIES, COMPOSITIONS, METHODS AND USES

(57) Abstract: The present invention relates to at least one novel EPO human CH1-deleted mimetibody or specified portion or variant, including isolated nucleic acids that encode at least one CH1-deleted mimetibody or specified portion or variant, CH1-deleted mimetibody or specified portion or variants, vectors, host cells, transgenic animals or plants, and methods of making and using thereof, including therapeutic compositions, methods and devices.

MAMMALIAN CH1 DELETED MIMETIBODIES, COMPOSITIONS, METHODS AND USES

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to mammalian CH1-deleted mimetibodies, specified portions and variants specific for bologically active proteins, fragment or ligands, CH1-deleted mimetibody encoding and complementary nucleic acids, host cells, and methods of making and using thereof, including therapeutic formulations, administration and devices.

RELATED ART

Recombinant proteins are an emerging class of therapeutic agents. Such recombinant therapeutics have engendered advances in protein formulation and chemical modification. Such modifications can potentially enhance the therapeutic utility of therapeutic proteins, such as by increaseing half lives (e.g., by blocking their exposure to proteolytic enzymes), enhancing biological activity, or reducing unwanted side effects. One such modification is the use of immunoglobulin fragments fused to receptor proteins, such as enteracept. Therapeutic proteins have also been constructed using the Fc domain to attempt to provide a longer half-life or to incorporate functions such as Fc receptor binding, protein A binding, and complement fixation.

One specific and vital role of the mammalian hematopoietic system is the production of erythrocytes, or red blood cells, which transport oxygen to the various tissues of the animal's body. The process of producing erythrocytes ("erythropoiesis") occurs continuously throughout an animal's life span to offset erythrocyte destruction. The typical red blood cell has a relatively short life-span, usually 100 to 120 days. Erythropoiesis is a precisely controlled physiological mechanism whereby sufficient numbers of erythrocytes are produced to enable proper tissue oxygenation, but not so many as to impede circulation.

Erythropoiesis is now known to be primarily controlled by the polypeptide erythropoietin (EPO), an acidic glycoprotein. Erythropoietin is produced as the result of the expression of a single copy gene located in a chromosome of a mammal. The amino acid sequence for recombinant human EPO ("rHuEPO") is substantially identical to the amino acid sequence for EPO obtained from human urinary sources. However, the glycosylation of rHuEPO differs from that of urinary EPO and human serum EPO.

In a healthy mammal, EPO is present in the blood plasma in very low concentrations, as the tissues are being sufficiently oxygenated by the existing number of circulating erythrocytes. The EPO

present stimulates the production of new erythrocytes to replace those lost to the aging process. Additionally, EPO production is stimulated under conditions of hypoxia, wherein the oxygen supply to the body's tissues is reduced below normal physiological levels despite adequate perfusion of the tissue by blood. Hypoxia may be caused by hemorrhaging, radiation-induced erythrocyte destruction, various anemias, high altitude, or long periods of unconsciousness. In contrast, should the number of red blood cells in circulation exceed what is needed for normal tissue oxygenation, EPO production is reduced.

However, certain disease states involve abnormal erythropoiesis. Recombinant human EPO (rHuEPO) is being used therapeutically in a number of countries. In the United States, the U.S. Food and Drug Administration (FDA) has approved rHuEPO's use in treating anemia associated with end-stage renal disease. Patients undergoing hemodialysis to treat this disorder typically suffer severe anemia, caused by the rupture and premature death of erythrocytes as a result of the dialysis treatment. EPO is also useful in the treatment of other types of anemia. For instance, chemotherapy-induced anemia, anemia associated with myelodysplasia, those associated with various congenital disorders, AIDS-related anemia, and prematurity-associated anemia, may be treated with EPO. Additionally, EPO may play a role in other areas, such as helping to more quickly restore a normal hematocrit in bone marrow transplantation patients, in patients preparing for autologous blood transfusions, and in patients suffering from iron overload disorders.

Erythropoietin (EPO) is a glycoprotein hormone composed of 165 amino acids and four carbohydrate chains that functions as the primary regulator of erythropoiesis by binding to a specific receptor on the surface of erythrocyte precursor cells. This binding signals their proliferation and differentiation into mature red blood cells. The erythropoietin receptor is a 484-amino acid glycoprotein with high affinity for erythropoietin. For the erythropoietin receptor, ligand-induced homodimerization is the key event that governs activation .

Erythropoietin has a relatively short half-life. Intravenously administered erythropoietin is eliminated at a rate consistent with first order kinetics with a circulating half-life ranging from approximately 3 to 4 hours in patients with CRF. Within the therapeutic dose range, detectable levels of plasma erythropoietin are maintained for at least 24 hours. After subcutaneous administration of erythropoietin, peak serum levels are achieved within 5-24 hours and decline slowly thereafter. The C max and t ½ after administration of erythropoietin were 1.80 ± 0.7 U/mL and 19.0 ± 5.9 hours, respectively.

Starting doses of erythropoietin range from 50-150 U/kg three times weekly. The dosage of erythropoietin must be individualized to maintain the hematocrit within the suggested target range. For surgery patients the recommended dose of erythropoietin is 300 U/kg/day s.c. for 10 days before surgery, on the day of surgery, and for 4 days after surgery or alternatively 600 U/kg s.c. in once

weekly doses (21, 14 and 7 days before surgery) plus a fourth dose on the day of surgery.

Small peptidomimetics of erythropoietin were identified by several groups through screening of random phage display peptide libraries for affinity to the erythropoietin receptor. These sequences have no homology with erythropoietin. In functional assays several of these peptides showed activity, but only 1/100,000th that of recombinant erythropoietin. Although several attempts have been made to increase the potency of these peptides by preparing covalent dimers or multimers of peptidomimetics, these compounds are still 1,000 - 10,000 fold less active than erythropoietin on a molar basis.

Peptide sequences from erythropoietin have also been claimed as agonistic. Increased activity of dimerized sequences comprising any or all of the native erythropoietin sequence has also been reported. These compounds have little or no oral bioavailability and their activity does not make them economically viable at this time.

Accordingly, there is a need to provide improved and/or modified versions of therapeutic proteins, which overcome one more of these and other problems known in the art.

SUMMARY OF THE INVENTION

The present invention provides isolated human CH1-deleted mimetibodies, including modified immunoglobulins, cleavage products and other specified portions and variants thereof, as well as CH1-deleted mimetibody compositions, encoding or complementary nucleic acids, vectors, host cells, compositions, formulations, devices, transgenic animals, transgenic plants, and methods of making and using thereof, as described and/or enabled herein, in combination with what is known in the art.

The present invention also provides at least one isolated CH1-deleted mimetibody or specified portion or variant as described herein and/or as known in the art. The CH1 deleted mimetibody can optionally comprise at least one CH3 region directly linked with at least one CH2 region directly linked with at least one hinge region or fragment thereof directly linked with at least one partial V region, directly linked with an optional linker sequence, directly linked to at least one therapeutic peptide, optionally further directly linked with at least a portion of at least one variable antibody sequence. In a preferred embodiment a pair of a CH3-CH2-hinge-partial J sequence-linker-therapeutic peptide with an option N-terminal antibody sequence, the pair optionally linked by association or covalent linkage, such as, but not limited to, a Cys-Cys disulfide bond. In one embodiment, a CH1 deleted mimetibody comprises formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is at least one portion of an N-terminus of an immunoglobulin variable region, Pep is at least one bioactive peptide, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is at least one portion of a C-

terminus of an immunoglobulin variable region, pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is at least a portion of an immunoglobulin CH2 constant region, CH3 is at least a portion of an immunoglobulin CH3 constant region, n and m can be an integer between 1 and 10, mimicing different types of immunoglobulin molecules, e.g., but not limited to IgG1, IgG2, IgG3, IgG4, IgA, IgM, IgD, IgE, and the like, or combination thereof.

Thus, a CH1-deleted mimetibody of the present invention mimics at least a portion of an antibody or immnuoglobulin structure or function with its inherent properties and functions, while providing a therapeutic peptide and its inherent or acquired in vitro, in vivo or in situ properties or activities. The various portions of the antibody and therapeutic peptide portions of at least one CH1-deleted mimetibody of the present invention can vary as described herein in combinatoin with what is known in the art.

The present invention provides, in one aspect, isolated nucleic acid molecules comprising, complementary, having significant identity or hybridizing to, a polynucleotide encoding specific mimetibodies or specified portions or variants thereof, comprising at least one specified sequence, domain, portion or variant thereof. The present invention further provides recombinant vectors comprising at least one of said isolated CH1-deleted mimetibody nucleic acid molecules, host cells containing such nucleic acids and/or recombinant vectors, as well as methods of making and/or using such CH1-deleted mimetibody nucleic acids, vectors and/or host cells.

At least one CH1-deleted mimetibody or specified portion or variant of the invention mimics the binding of the Pep portion of the mimetibody to at least one ligand, or has at least one biological activity of, at least one protein, subunit, fragment, portion or any combination thereof.

The present invention also provides at least one isolated CH1-deleted mimetibody or specified portion or variant as described herein and/or as known in the art, wherein the CH1-deleted mimetibody or specified portion or variant has at least one activity, such as, but not limited to known biological activities of at least one bioactive peptide or polypeptide corresponding to the Pep portion of formula I. A CH1-deleted mimetibody can thus be screened for a corresponding activity according to known methods, such as at least one neutralizing activity towards a protein or fragment thereof.

The present invention also provides at least one composition comprising (a) an isolated CH1-deleted mimetibody or specified portion or variant encoding nucleic acid and/or CH1-deleted mimetibody as described herein; and (b) a suitable carrier or diluent. The carrier or diluent can optionally be pharmaceutically acceptable, according to known methods. The composition can optionally further comprise at least one further compound, protein or composition.

The present invention also provides at least one method for expressing at least one CH1-deleted mimetibody or specified portion or variant in a host cell, comprising culturing a host cell as described

herein and/or as known in the art under conditions wherein at least one CH1-deleted mimetibody or specified portion or variant is expressed in detectable and/or recoverable amounts.

The present invention further provides at least one CH1-deleted mimetibody, specified portion or variant in a method or composition, when administered in a therapeutically effective amount, for modulation, for treating or reducing the symptoms of at least one of a bone and joint disorder, cardiovascular disoder, a dental or oral disorder, a dermatologic disorder, an ear, nose or throat disorder, an endocrine or metabolic disorder, a gastrointestinal disorder, a gynecologic disorder, a hepatic or biliary disorder, a an obstetric disorder, a hematologic disorder, an immunologic or allergic disorder, an infectious disease, a musculoskeletal disorder, a oncologic disorder, a neurologic disorder, a nutritrional disorder, an opthalmologic disorder, a pediatric disorder, a poisoning disorder, a psychiatric disorder, a renal disorder, a pulmonary disorder, or any other known disorder. (See., e.g., The Merck Manual, 17th ed. , Merck Research Laboratories, Merck and Co., Whitehouse Station, NJ (1999), entirely incoporated herein by reference), as needed in many different conditions, such as but not limited to, prior to, subsequent to, or during a related disease or treatment condition, as known in the art.

The present invention further provides at least one CH1-deleted mimetibody, specified portion or variant in a method or composition, when administered in a therapeutically effective amount, for modulation, for treating or reducing the symptoms of, at least one immune, cardiovascular, infectious, malignant, and/or neurologic disease in a cell, tissue, organ, animal or patient and/or, as needed in many different conditions, such as but not limited to, prior to, subsequent to, or during a related disease or treatment condition, as known in the art and/or as described herein.

The present invention also provides at least one composition, device and/or method of delivery of a therapeutically or prophylactically effective amount of at least one CH1-deleted mimetibody or specified portion or variant, according to the present invention.

The present invention further provides at least one anti-idiotype antibody to at least one CH1-deleted mimetibody of the present invention. The anti-idiotype antibody includes any protein or peptide containing molecule that comprises at least a portion of an immunoglobulin molecule, such as but not limited to at least one complimetarity determing region (CDR) of a heavy or light chain or a ligand binding portion thereof, a heavy chain or light chain variable region, a heavy chain or light chain constant region, a framework region, or any portion thereof, that can be incorporated into a CH1-deleted mimetibody of the present invention. A CH1-deleted mimetibody of the invention can include or be derived from any mammal, such as but not limited to a human, a mouse, a rabbit, a rat, a rodent, a primate, and the like.

The present invention provides, in one aspect, isolated nucleic acid molecules comprising, complementary, or hybridizing to, a polynucleotide encoding at least one CH1-deleted mimetibody

anti-idiotype antibody, comprising at least one specified sequence, domain, portion or variant thereof. The present invention further provides recombinant vectors comprising said CH1-deleted mimetibody anti-idiotype antibody encoding nucleic acid molecules, host cells containing such nucleic acids and/or recombinant vectors, as well as methods of making and/or using such anti-idiotype antiobody nucleic acids, vectors and/or host cells.

The present invention also provides at least one method for expressing at least one CH1-deleted mimetibody, or CH1-deleted mimetibody anti-idiotype antibody, in a host cell, comprising culturing a host cell as described herein under conditions wherein at least one CH1-deleted mimetibody or anti-idiotype antibody is expressed in detectable and/or recoverable amounts.

The present invention also provides at least one composition comprising (a) an isolated CH1-deleted mimetibody encoding nucleic acid and/or CH1-deleted mimetibody as described herein; and (b) a suitable carrier or diluent. The carrier or diluent can optionally be pharmaceutically acceptable, according to known carriers or diluents. The composition can optionally further comprise at least one further compound, protein or composition.

The present invention further provides at least one CH1-deleted mimetibody method or composition, for administering a therapeutically effective amount to modulate or treat at least one protein related condition in a cell, tissue, organ, animal or patient and/or, prior to, subsequent to, or during a related condition, as known in the art and/or as described herein.

The present invention also provides at least one composition, device and/or method of delivery of a therapeutically or prophylactically effective amount of at least one CH1-deleted mimetibody, according to the present invention.

The present invention further provides at least one CH1-deleted mimetibody method or composition, for diagnosing at least one protein related condition in a cell, tissue, organ, animal or patient and/or, prior to, subsequent to, or during a related condition, as known in the art and/or as described herein.

The present invention also provides at least one composition, device and/or method of delivery for diagnosing of at least one CH1-deleted mimetibody, according to the present invention.

In one aspect, the present invention provides at least one isolated mammalian CH1-deleted mimetibody, comprising at least one Pep(n) region comprising at least a portion of at least one CDR that further comprises at least one of SEQID NOS:1-1109.

In other aspect the present invention provides at least one isolated mammalian CH1-deleted mimetibody, wherein the CH1-deleted mimetibody specifically binds at least one epitope comprising at least 1-3 of at least one ligand or binding region which ligand binds to at least a portion of at least one of SEQID NOS: 1-1109.

The at least one CH1-deleted mimetibody can optionally further at least one of: bind protein

with an affinity of at least one selected from at least 10^{-9} M, at least 10^{-10} M, at least 10^{-11} M, or at least 10^{-12} M; substantially neutralize at least one activity of at least one protein or portion thereof. Also provided is an isolated nucleic acid encoding at least one isolated mammalian CH1-deleted mimetibody; an isolated nucleic acid vector comprising the isolated nucleic acid, and/or a prokaryotic or eukaryotic host cell comprising the isolated nucleic acid. The host cell can optionally be at least one selected from COS-1, COS-7, HEK293, BHK21, CHO, BSC-1, Hep G2, 653, SP2/0, 293, HeLa, myeloma, or lymphoma cells, or any derivative, immortalized or transformed cell thereof. Also provided is a method for producing at least one CH1-deleted mimetibody, comprising translating the CH1-deleted mimetibody encoding nucleic acid under conditions in vitro, in vivo or in situ, such that the CH1-deleted mimetibody is expressed in detectable or recoverable amounts.

Also provided is a composition comprising at least one isolated mammalian CH1-deleted mimetibody and at least one pharmaceutically acceptable carrier or diluent. The composition can optionally further comprise an effective amount of at least one compound or protein selected from at least one of a detectable label or reporter, an anti-infective drug, a cardiovascular (CV) system drug, a central nervous system (CNS) drug, an autonomic nervous system (ANS) drug, a respiratory tract drug, a gastrointestinal (GI) tract drug, a hormonal drug, a drug for fluid or electrolyte balance, a hematologic drug, an antineoplactic, an immunomodulation drug, an ophthalmic, otic or nasal drug, a topical drug, a nutritional drug, a TNF antagonist, an antirheumatic, a muscle relaxant, a narcotic, a non-steroid anti-inflammatory drug (NTHE), an analgesic, an anesthetic, a sedative, a local anethetic, a neuromuscular blocker, an antimicrobial, an antipsoriatic, a corticosteriod, an anabolic steroid, an erythropoietin, an immunization, an immunoglobulin, an immunosuppressive, a growth hormone, a hormone replacement drug, a radiopharmaceutical, an antidepressant, an antipsychotic, a stimulant, an asthma medication, a beta agonist, an inhaled steroid, an epinephrine or analog, a cytokine, or a cytokine antagonist.

The present invention further provides an anti-idiotype antibody or fragment that specifically binds at least one CH1 deleted mimetibody of the present invention.

Also provided is a method for diagnosing or treating a disease condition in a cell, tissue, organ or animal, comprising

(a) contacting or administering a composition comprising an effective amount of at least one isolated mammalian CH1-deleted mimetibody of the invention with, or to, the cell, tissue, organ or animal. The method can optionally further comprise using an effective amount of 0.001-50 mg/kilogram of the cells, tissue, organ or animal. The method can optionally further comprise using the contacting or the administrating by at least one mode selected from parenteral, subcutaneous, intramuscular, intravenous, intrarticular, intrabronchial, intraabdominal, intracapsular, intracartilaginous, intracavitary, intracelial, intracelebellar, intracerebroventricular, intracolic, intracervical, intragastric, intrahepatic, intramyocardial, intraosteal, intrapelvic, intrapericardiac,

intraperitoneal, intrapleural, intraprostatic, intrapulmonary, intrarectal, intrarenal, intraretinal, intraspinal, intrasynovial, intrathoracic, intrauterine, intravesical, bolus, vaginal, rectal, buccal, sublingual, intranasal, or transdermal. The method can optionally further comprise administering, prior, concurrently or after the (a) contacting or administering, at least one composition comprising an effective amount of at least one compound or protein selected from at least one of a detectable label or reporter, an anti-infective drug, a cardiovascular (CV) system drug, a central nervous system (CNS) drug, an autonomic nervous system (ANS) drug, a respiratory tract drug, a gastrointestinal (GI) tract drug, a hormonal drug, a drug for fluid or electrolyte balance, a hematologic drug, an antineoplactic, an immunomodulation drug, an ophthalmic, otic or nasal drug, a topical drug, a nutritional drug, a TNF antagonist, an antirheumatic, a muscle relaxant, a narcotic, a non-steroid anti-inflammatory drug (NSAID), an analgesic, an anesthetic, a sedative, a local anethetic, a neuromuscular blocker, an antimicrobial, an antipsoriatic, a corticosteriod, an anabolic steroid, an erythropoietin, an immunization, an immunoglobulin, an immunosuppressive, a growth hormone, a hormone replacement drug, a radiopharmaceutical, an antidepressant, an antipsychotic, a stimulant, an asthma medication, a beta agonist, an inhaled steroid, an epinephrine or analog, a cytokine, or a cytokine antagonist.

Also provided is a medical device, comprising at least one isolated mammalian CH1-deleted mimetibody of the invention, wherein the device is suitable to contacting or administerting the at least one CH1-deleted mimetibody by at least one mode selected from parenteral, subcutaneous, intramuscular, intravenous, intrarticular, intrabronchial, intraabdominal, intracapsular, intracartilaginous, intracavitary, intracelial, intracelebellar, intracerebroventricular, intracolic, intracervical, intragastric, intrahepatic, intramyocardial, intraosteal, intrapelvic, intrapericardiac, intraperitoneal, intrapleural, intraprostatic, intrapulmonary, intrarectal, intrarenal, intraretinal, intraspinal, intrasynovial, intrathoracic, intrauterine, intravesical, bolus, vaginal, rectal, buccal, sublingual, intranasal, or transdermal.

Also provided is an article of manufacture for human pharmaceutical or diagnostic use, comprising packaging material and a container comprising a solution or a lyophilized form of at least one isolated mammalian CH1-deleted mimetibody of the present invention. The article of manufacture can optionally comprise having the container as a component of a parenteral, subcutaneous, intramuscular, intravenous, intrarticular, intrabronchial, intraabdominal, intracapsular, intracartilaginous, intracavitary, intracelial, intracelebellar, intracerebroventricular, intracolic, intracervical, intragastric, intrahepatic, intramyocardial, intraosteal, intrapelvic, intrapericardiac, intraperitoneal, intrapleural, intraprostatic, intrapulmonary, intrarectal, intrarenal, intraretinal, intraspinal, intrasynovial, intrathoracic, intrauterine, intravesical, bolus, vaginal, rectal, buccal, sublingual, intranasal, or transdermal delivery device or system.

Also provided is a method for producing at least one isolated mammalian CH1-deleted

mimetibody of the present invention, comprising providing a host cell or transgenic animal or transgenic plant or plant cell capable of expressing in recoverable amounts the CH1-deleted mimetibody. Further provided in the present invention is at least one CH1-deleted mimetibody produced by the above method.

The present invention also provides at least one method for expressing at least one CH1-deleted mimetibody, or anti-idiotype antibody, in a host cell, comprising culturing a host cell as described herein under conditions wherein at least one CH1-deleted mimetibody is expressed in detectable and/or recoverable amounts.

The present invention further provides any invention described herein.

DESCRIPTION OF THE INVENTION

The present invention provides isolated, recombinant and/or synthetic mimetibodies or specified portions or variants, as well as compositions and encoding nucleic acid molecules comprising at least one polynucleotide encoding at least one CH1-deleted mimetibody. Such mimetibodies or specified portions or variants of the present invention comprise specific CH1-deleted mimetibody sequences, domains, fragments and specified variants thereof, and methods of making and using said nucleic acids and mimetibodies or specified portions or variants, including therapeutic compositions, methods and devices.

The present invention also provides at least one isolated CH1-deleted mimetibody or specified portion or variant as described herein and/or as known in the art. The CH1 deleted mimetibody can optionally comprise at least one CH3 region directly linked with at least one CH2 region directly linked with at least one hinge region or fragment thereof directly linked with at least one partial V region, directly linked with an optional linker sequence, directly linked to at least one therapeutic peptide, optionally further directly linked with at least a portion of at least one variable antibody sequence.

In a preferred embodiment a CH1 deleted mimetibody comprises formula (I):

$$(V1(n)\text{-}Pep(n)\text{-}Flex(n)\text{-}V2(n)\text{-}pHinge(n)\text{-}CH2(n)\text{-}CH3(n))(m),$$

where V1 is at least one portion of an N-terminus of an immunoglobulin variable region, Pep is at least one bioactive peptide, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is at least one portion of a C-terminus of an immunoglobulin variable region, pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is at least a portion of an immunoglobulin CH2 constant region, CH3 is at least a portion of an immunoglobulin CH3 constant region, n and m can be an integer between 1 and 10, mimicing different types of immunoglobulin molecules, e.g., but not limited to IgG1, IgG2, IgG3,

IgG4, IgA, IgM, IgD, IgE, and the like, or combination thereof. The monomer where m=1 can be linked to other monomers by association or covalent linkage, such as, but not limited to, a Cys-Cys disulfide bond. Thus, a CH1-deleted mimetibody of the present invention mimics an antibody structure with its inherent properties and functions, while providing a therapeutic peptide and its inherent or acquired in vitro, in vivo or in situ properties or activities. The various portions of the antibody and therapeutic peptide portions of at least one CH1-deleted mimetibody of the present invention can vary as described herein in combinatoin with what is known in the art.

As used herein, a "CH1-deleted mimetibody," "CH1-deleted mimetibody portion," or "CH1-deleted mimetibody fragment" and/or "CH1-deleted mimetibody variant" and the like mimics, has or simulates at least one ligand binding or at least one biological activity of at least one protein, such as ligand binding or activity *in vitro, in* situ and/or preferably in *vivo,* such as but not limited to at least one of SEQ ID NOS:1-1110. For example, a suitable CH1-deleted mimetibody, specified portion or variant of the present invention can bind at least one protein ligand and includes at least one protein ligand, receptor, soluble receptor, and the like. A suitable CH1-deleted mimetibody, specified portion, or variant can also modulate, increase, modify, activate, at least one protein receptor signaling or other measurable or detectable activity.

Mimetibodies useful in the methods and compositions of the present invention are characterized by suitable affinity binding to protein ligands or receptors and optionally and preferably having low toxicity. In particular, a CH1-deleted mimetibody, where the individual components, such as the portion of variable region, constant region (without a CH1 portion) and framework, or any portion thereof (e.g., a portion of the J, D or V rgions of the variable heavy or light chain; the hinge region, the constant heavy chain or light chain, and the like) individually and/or collectively optionally and preferably possess low immunogenicity, is useful in the present invention. The mimetibodies that can be used in the invention are optionally characterized by their ability to treat patients for extended periods with good to excellent alleviation of symptoms and low toxicity. Low immunogenicity and/or high affinity, as well as other undefined properties, may contribute to the therapeutic results achieved. "Low immunogenicity" is defined herein as raising significant HAMA, HACA or HAHA responses in less than about 75%, or preferably less than about 50, 45, 40, 35, 30, 35, 20, 15, 10, 9, 8, 7, 6, 5, 4, 3, 2, and/or 1 % of the patients treated and/or raising low titres in the patient treated (less than about 300, preferably less than about 100 measured with a double antigen enzyme immunoassay) (see, e.g., Elliott *et al., Lancet 344*:1125-1127 (1994)).

Utility

The isolated nucleic acids of the present invention can be used for production of at least one CH1-deleted mimetibody, fragment or specified variant thereof, which can be used to effect in an cell, tissue, organ or animal (including mammals and humans), to modulate, treat, alleviate, help prevent the

incidence of, or reduce the symptoms of, at least one protein related condition, selected from, but not limited to, at least one of an immune disorder or disease, a cardiovascular disorder or disease, an infectious, malignant, and/or neurologic disorder or disease, a(n) anemia; a(n) immune/autoimmune; and/or a(n) cancer/infecteous, as well as other known or specified protein related conditions.

Such a method can comprise administering an effective amount of a composition or a pharmaceutical composition comprising at least one CH1-deleted mimetibody or specified portion or variant to a cell, tissue, organ, animal or patient in need of such modulation, treatment, alleviation, prevention, or reduction in symptoms, effects or mechanisms. The effective amount can comprise an amount of about 0.0001 to 500 mg/kg per single or multiple administration, or to achieve a serum concentration of 0.0001-5000 μg/ml serum concentration per single or multiple adminstration, or any effective range or value therein, as done and determined using known methods, as described herein or known in the relevant arts.

Citations

All publications or patents cited herein are entirely incorporated herein by reference as they show the state of the art at the time of the present invention and/or to provide description and enablement of the present invention. Publications refer to any scientific or patent publications, or any other information available in any media format, including all recorded, electronic or printed formats. The following references are entirely incorporated herein by reference: Ausubel, et al., ed., Current Protocols in Molecular Biology, John Wiley & Sons, Inc., NY, NY (1987-2002); Sambrook, et al., Molecular Cloning: A Laboratory Manual, 2nd Edition, Cold Spring Harbor, NY (1989); Harlow and Lane, Antibodies, a Laboratory Manual, Cold Spring Harbor, NY (1989); Colligan, et al., eds., Current Protocols in Immunology, John Wiley & Sons, Inc., NY (1994-2002); Colligan et al., Current Protocols in Protein Science, John Wiley & Sons, NY, NY, (1997-2002).

Mimetibodies of the Present Invention

The CH1 deleted mimetibody can comprise at least one CH3 region directly linked with at least one CH2 region directly linked with at least one hinge region or fragment thereof directly linked with at least one partial V region, directly linked with an optional linker sequence, directly linked to at least one therapeutic peptide, optionally further directly linked with at least a portion of at least one variable antibody sequence. In a preferred embodiment a pair of a CH3-CH2-hinge-partial J sequence-linker-therapeutic peptide with an option N-terminal antibody sequence, the pair linked by association or covalent linkage, such as, but not limited to, a Cys-Cys disulfide bond. Thus, a CH1-deleted mimetibody of the present invention mimics an antibody structure with its inherent properties and functions, while providing a therapeutic peptide and its inherent or acquired in vitro, in vivo or in situ properties or activities. The various portions of the antibody and therapeutic peptide portions of at least

one CH1-deleted mimetibody of the present invention can vary as described herein in combinatoin with what is known in the art.

In particular, mimetibodies comprise at least one ligand binding region (LBR) that corresponds to at least one portion of at least one complementarity determining region (CDR, e.g., CDR1, CDR2 or CDR3 of HC or LC variable region) of at least one antibody or fragment or portion thereof where at least one ligand protein is inserted into or replaces at least a portion of at least one CDR of the antibody or portion thereof. Such mimetibodies of the present invention thus provide at least one suitable property as compared to known proteins, such as, but not limited to, at least one of increased half-life, increased activity, more specific activity, increased avidity, increased or descrease off rate, a selected or more suitable subset of activities, less immungenicity, increased quality or duration of at least one desired therapeutic effect, less side effects, and the like.

Such fragments can be produced by enzymatic cleavage, synthetic or recombinant techniques, as known in the art and/or as described herein. For example, papain or pepsin cleavage can generate CH1-deleted mimetibody Fab or $F(ab')_2$ fragments, respectively. Other proteases with the requisite substrate specificity can also be used to generate Fab or $F(ab')_2$ fragments or portions thereof. Mimetibodies can also be produced in a variety of truncated forms using antibody genes in which one or more stop codons have been introduced upstream of the natural stop site. For example, a chimeric gene encoding a $F(ab')_2$ heavy chain portion can be designed to include DNA sequences encoding the CH_1 domain and/or hinge region of the heavy chain. The various portions of mimetibodies can be joined together chemically by conventional techniques, or can be prepared as a contiguous protein using genetic engineering techniques. For example, a nucleic acid encoding the variable and constant regions of a human antibody chain can be expressed to produce a contiguous protein for use in mimetibodies of the present invention. See, e.g., Ladner *et al.*, U.S. Patent No. 4,946,778 and Bird, R.E. *et al., Science, 242:* 423-426 (1988), regarding single chain mimetibodies.

As used herein, the term "human antibody" refers to an antibody in which substantially every part of the protein (e.g., LBR, framework, C_L, C_H domains (e.g., C_H1, C_H2, C_H3), hinge, (V_L, V_H)) is substantially non-immunogenic, with only minor sequence changes or variations. Such changes or variations optionally and preferably retain or reduce the immunogenicity in humans relative to non-modified human antibodies, or mimetibodies of the prsent invention. Thus, a human antibody and corresponding CH1-deleted mimetibody of the present invention is distinct from a chimeric or humanized antibody. It is pointed out that a human antibody and CH1-deleted mimetibody can be produced by a non-human animal or cell that is capable of expressing functionally rearranged human immunoglobulin (e.g., heavy chain and/or light chain) genes, and for a CH1-deleted mimetibody, wherein at least one Ig CDR is replaced by an LBR of at least one ligand protein or fragment.

Human mimetibodies that are specific for at least one protein ligand or receptor thereof can be designed against an appropriate ligand, such as isolated and/or protein receptor or ligand, or a portion thereof (including synthetic molecules, such as synthetic peptides). Preparation of such mimetibodies are performed using known techniques to identify and characterize ligand binding regions or sequences of at least one protein or portion thereof.

In a preferred embodiment a CH1 deleted mimetibody comprises formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is at least one portion of an N-terminus of an immunoglobulin variable region, Pep is at least one bioactive peptide, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is at least one portion of a C-terminus of an immunoglobulin variable region, pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is at least a portion of an immunoglobulin CH2 constant region, CH3 is at least a portion of an immunoglobulin CH3 constant region, n and m can be an integer between 1 and 10, mimicing different types of immunoglobulin molecules, e.g., but not limited to IgG1, IgG2, IgG3, IgG4, IgA, IgM, IgD, IgE, and the like, or combination thereof. The monomer where m=1 can be linked to other monomers by association or covalent linkage, such as, but not limited to, a Cys-Cys disulfide bond.

In a preferred embodiment, at least one CH1-deleted mimetibody or specified portion or variant of the present invention is produced by at least one cell line, mixed cell line, immortalized cell or clonal population of immortalized and/or cultured cells. Immortalized protein producing cells can be produced using suitable methods. Preferably, the at least one CH1-deleted mimetibody or specified portion or variant is generated by providing nucleic acid or vectors comprising DNA derived or having a substantially similar sequence to, at least one human immunoglobulin locus that is functionally rearranged, or which can undergo functional rearrangement, and which further comprises a mimetibody structure as described herein, e.g., but not limited to Formula (I), wherein known portions of :C- and N-termiinal variable regions can be used for V1 and V2, hinge regions for pHinge, CH2 for CH2 and CH3 for CH3, as known in the art.

The term "functionally rearranged," as used herein refers to a segment of nucleic acid from an immunoglobulin locus that has undergone V(D)J recombination, thereby producing an immunoglobulin gene that encodes an immunoglobulin chain (e.g., heavy chain, light chain), or any portion thereof. A functionally rearranged immunoglobulin gene can be directly or indirectly identified using suitable methods, such as, for example, nucleotide sequencing, hybridization (e.g., Southern blotting, Northern blotting) using probes that can anneal to coding joints between gene segments or enzymatic amplification of immunoglobulin genes (e.g., polymerase chain reaction) with primers that can anneal to coding joints between gene segments. Whether a cell produces an CH1-deleted mimetibody or

portion or variant comprising a particular variable region or a variable region comprising a particular sequence (e.g., at least one Pep sequence can also be determined using suitable methods.

Mimetibodies, specified portions and variants of the present invention can also be prepared using at least one CH1-deleted mimetibody or specified portion or variant encoding nucleic acid to provide transgenic animals or mammals, such as goats, cows, horses, sheep, and the like, that produce such mimetibodies or specified portions or variants in their milk. Such animals can be provided using known methods as applied for antibody encoding sequences. See, e.g., but not limited to, US patent nos. 5,827,690; 5,849,992; 4,873,316; 5,849,992; 5,994,616; 5,565,362; 5,304,489, and the like, each of which is entirely incorporated herein by reference.

Mimetibodies, specified portions and variants of the present invention can additionally be prepared using at least one CH1-deleted mimetibody or specified portion or variant encoding nucleic acid to provide transgenic plants and cultured plant cells (e.g., but not limited to tobacco and maize) that produce such mimetibodies, specified portions or variants in the plant parts or in cells cultured therefrom. As a non-limiting example, transgenic tobacco leaves expressing recombinant proteins have been successfully used to provide large amounts of recombinant proteins, e.g., using an inducible promoter. See, e.g., Cramer et al., Curr. Top. Microbol. Immunol. 240:95-118 (1999) and references cited therein. Also, transgenic maize have been used to express mammalian proteins at commercial production levels, with biological activities equivalent to those produced in other recombinant systems or purified from natural sources. See, e.g., Hood et al., Adv. Exp. Med. Biol. 464:127-147 (1999) and references cited therein. Antibodies have also been produced in large amounts from transgenic plant seeds including antibody fragments, such as single chain mimetibodies (scFv's), including tobacco seeds and potato tubers. See, e.g., Conrad et al., Plant Mol. Biol. 38:101-109 (1998) and references cited therein. Thus, mimetibodies, specified portions and variants of the present invention can also be produced using transgenic plants, according to know methods. See also, e.g., Fischer et al., Biotechnol. Appl. Biochem. 30:99-108 (Oct., 1999), Ma et al., Trends Biotechnol. 13:522-7 (1995); Ma et al., Plant Physiol. 109:341-6 (1995); Whitelam et al., Biochem. Soc. Trans. 22:940-944 (1994); and references cited therein. The above references are entirely incorporated herein by reference.

The mimetibodies of the invention can bind human protein ligands with a wide range of affinities (K_D). In a preferred embodiment, at least one human CH1-deleted mimetibody of the present invention can optionally bind at least one protein ligand with high affinity. For example, at least one CH1-deleted mimetibody of the present invention can bind at least one protein ligand with a K_D equal to or less than about 10^{-9} M or, more preferably, with a K_D equal to or less than about 0.1-9.9 (or any range or value therein) X 10^{-10} M, 10^{-11}, 10^{-12}, 10^{-13} or any range or value therein.

The affinity or avidity of a CH1-deleted mimetibody for at least one protein ligand can be determined experimentally using any suitable method, e.g., as used for determing antibody-antigen

binding affinity or avidity. (See, for example, Berzofsky, *et al.*, "Antibody-Antigen Interactions," in *Fundamental Immunology*, Paul, W. E., Ed., Raven Press: New York, NY (1984); Kuby, Janis *Immunology*, W. H. Freeman and Company: New York, NY (1992); and methods described herein). The measured affinity of a particular CH1-deleted mimetibody-ligand interaction can vary if measured under different conditions (e.g., salt concentration, pH). Thus, measurements of affinity and other ligand-binding parameters (e.g., K_D, K_a, K_d) are preferably made with standardized solutions of CH1-deleted mimetibody and ligand, and a standardized buffer, such as the buffer described herein.

Nucleic Acid Molecules

Using the information provided herein, such as the nucleotide sequences encoding at least 90-100% of the contiguous amino acids of at least one of SEQID NOS:1-1009 as well as at least one portion of an antibody, wherein the above sequences are inserted as the Pep sequence of Formula (I) to provide a CH1-deleted mimetibody of the present invention, further comprising specified fragments, variants or consensus sequences thereof, or a deposited vector comprising at least one of these sequences, a nucleic acid molecule of the present invention encoding at least one CH1-deleted mimetibody or specified portion or variant can be obtained using methods described herein or as known in the art.

Nucleic acid molecules of the present invention can be in the form of RNA, such as mRNA, hnRNA, tRNA or any other form, or in the form of DNA, including, but not limited to, cDNA and genomic DNA obtained by cloning or produced synthetically, or any combination thereof. The DNA can be triple-stranded, double-stranded or single-stranded, or any combination thereof. Any portion of at least one strand of the DNA or RNA can be the coding strand, also known as the sense strand, or it can be the non-coding strand, also referred to as the anti-sense strand.

Isolated nucleic acid molecules of the present invention can include nucleic acid molecules comprising an open reading frame (ORF), optionally with one or more introns, nucleic acid molecules comprising the coding sequence for a CH1-deleted mimetibody or specified portion or variant; and nucleic acid molecules which comprise a nucleotide sequence substantially different from those described above but which, due to the degeneracy of the genetic code, still encode at least one CH1-deleted mimetibody as described herein and/or as known in the art. Of course, the genetic code is well known in the art. Thus, it would be routine for one skilled in the art to generate such degenerate nucleic acid variants that code for specific CH1-deleted mimetibody or specified portion or variants of the present invention. See, e.g., Ausubel, et al., *supra*, and such nucleic acid variants are included in the present invention.

In another aspect, the invention provides isolated nucleic acid molecules encoding a(n) CH1-deleted mimetibody or specified portion or variant having an amino acid sequence as encoded by the nucleic acid contained in the plasmid deposited as designated clone names

_____and ATCC Deposit Nos.

_____, respectively, deposited on

_____.

As indicated herein, nucleic acid molecules of the present invention which comprise a nucleic acid encoding a CH1-deleted mimetibody or specified portion or variant can include, but are not limited to, those encoding the amino acid sequence of a CH1-deleted mimetibody fragment, by itself; the coding sequence for the entire CH1-deleted mimetibody or a portion thereof; the coding sequence for a CH1-deleted mimetibody, fragment or portion, as well as additional sequences, such as the coding sequence of at least one signal leader or fusion peptide, with or without the aforementioned additional coding sequences, such as at least one intron, together with additional, non-coding sequences, including but not limited to, non-coding 5' and 3' sequences, such as the transcribed, non-translated sequences that play a role in transcription, mRNA processing, including splicing and polyadenylation signals (for example - ribosome binding and stability of mRNA); an additional coding sequence that codes for additional amino acids, such as those that provide additional functionalities. Thus, the sequence encoding a CH1-deleted mimetibody or specified portion or variant can be fused to a marker sequence, such as a sequence encoding a peptide that facilitates purification of the fused CH1-deleted mimetibody or specified portion or variant comprising a CH1-deleted mimetibody fragment or portion.

Polynucleotides Which Selectively Hybridize to a Polynucleotide as Described Herein

The present invention provides isolated nucleic acids that hybridize under selective hybridization conditions to a polynucleotide disclosed herein, or others disclosed herein, including specified variants or portions thereof. Thus, the polynucleotides of this embodiment can be used for isolating, detecting, and/or quantifying nucleic acids comprising such polynucleotides.

Low or moderate stringency hybridization conditions are typically, but not exclusively, employed with sequences having a reduced sequence identity relative to complementary sequences. Moderate and high stringency conditions can optionally be employed for sequences of greater identity. Low stringency conditions allow selective hybridization of sequences having about 40-99% sequence identity and can be employed to identify orthologous or paralogous sequences.

Optionally, polynucleotides of this invention will encode at least a portion of a CH1-deleted mimetibody or specified portion or variant encoded by the polynucleotides described herein. The polynucleotides of this invention embrace nucleic acid sequences that can be employed for selective hybridization to a polynucleotide encoding a CH1-deleted mimetibody or specified portion or variant of the present invention. See, e.g., Ausubel, supra; Colligan, supra, each entirely incorporated herein by reference.

Construction of Nucleic Acids

The isolated nucleic acids of the present invention can be made using (a) recombinant methods, (b) synthetic techniques, (c) purification techniques, or combinations thereof, as well-known in the art.

The nucleic acids can conveniently comprise sequences in addition to a polynucleotide of the present invention. For example, a multi-cloning site comprising one or more endonuclease restriction sites can be inserted into the nucleic acid to aid in isolation of the polynucleotide. Also, translatable sequences can be inserted to aid in the isolation of the translated polynucleotide of the present invention. For example, a hexa-histidine marker sequence provides a convenient means to purify the proteins of the present invention. The nucleic acid of the present invention - excluding the coding sequence - is optionally a vector, adapter, or linker for cloning and/or expression of a polynucleotide of the present invention.

Additional sequences can be added to such cloning and/or expression sequences to optimize their function in cloning and/or expression, to aid in isolation of the polynucleotide, or to improve the introduction of the polynucleotide into a cell. Use of cloning vectors, expression vectors, adapters, and linkers is well known in the art. See, e.g., Ausubel, *supra*; or Sambrook, *supra*.

Recombinant Methods for Constructing Nucleic Acids

The isolated nucleic acid compositions of this invention, such as RNA, cDNA, genomic DNA, or any combination thereof, can be obtained from biological sources using any number of cloning methodologies known to those of skill in the art. In some embodiments, oligonucleotide probes that selectively hybridize, under suitable stringency conditions, to the polynucleotides of the present invention are used to identify the desired sequence in a cDNA or genomic DNA library. The isolation of RNA, and construction of cDNA and genomic libraries, is well known to those of ordinary skill in the art. (See, e.g., Ausubel, *supra*; or Sambrook, *supra*).

Synthetic Methods for Constructing Nucleic Acids

The isolated nucleic acids of the present invention can also be prepared by direct chemical synthesis by known methods (see, e.g., Ausubel, et al., supra). Chemical synthesis generally produces a single-stranded oligonucleotide, which can be converted into double-stranded DNA by hybridization with a complementary sequence, or by polymerization with a DNA polymerase using the single strand as a template. One of skill in the art will recognize that while chemical synthesis of DNA can be limited to sequences of about 100 or more bases, longer sequences can be obtained by the ligation of shorter sequences.

Recombinant Expression Cassettes

The present invention further provides recombinant expression cassettes comprising a nucleic acid of the present invention. A nucleic acid sequence of the present invention, for example a cDNA or a genomic sequence encoding a CH1-deleted mimetibody or specified portion or variant of the present invention, can be used to construct a recombinant expression cassette that can be introduced into at least

one desired host cell. A recombinant expression cassette will typically comprise a polynucleotide of the present invention operably linked to transcriptional initiation regulatory sequences that will direct the transcription of the polynucleotide in the intended host cell. Both heterologous and non-heterologous (i.e., endogenous) promoters can be employed to direct expression of the nucleic acids of the present invention.

In some embodiments, isolated nucleic acids that serve as promoter, enhancer, or other elements can be introduced in the appropriate position (upstream, downstream or in intron) of a non-heterologous form of a polynucleotide of the present invention so as to up or down regulate expression of a polynucleotide of the present invention. For example, endogenous promoters can be altered *in vivo* or *in vitro* by mutation, deletion and/or substitution, as known in the art. A polynucleotide of the present invention can be expressed in either sense or anti-sense orientation as desired. It will be appreciated that control of gene expression in either sense or anti-sense orientation can have a direct impact on the observable characteristics. Another method of suppression is sense suppression. Introduction of nucleic acid configured in the sense orientation has been shown to be an effective means by which to block the transcription of target genes.

Vectors And Host Cells

The present invention also relates to vectors that include isolated nucleic acid molecules of the present invention, host cells that are genetically engineered with the recombinant vectors, and the production of at least one CH1-deleted mimetibody or specified portion or variant by recombinant techniques, as is well known in the art. See, e.g., Sambrook, et al., supra; Ausubel, et al., supra, each entirely incorporated herein by reference.

The polynucleotides can optionally be joined to a vector containing a selectable marker for propagation in a host. Generally, a plasmid vector is introduced into a cell using suitable known methods, such as electroporation and the like, other known methods include the use of the vector as a precipitate, such as a calcium phosphate precipitate, or in a complex with a charged lipid. If the vector is a virus, it can be packaged in vitro using an appropriate packaging cell line and then transduced into host cells.

The DNA insert should be operatively linked to an appropriate promoter. The expression constructs will further contain sites optionally for at least one of transcription initiation, termination and, in the transcribed region, a ribosome binding site for translation. The coding portion of the mature transcripts expressed by the constructs will preferably include a translation initiating at the beginning and a termination codon (e.g., UAA, UGA or UAG) appropriately positioned at the end of the mRNA to be translated, with UAA and UAG preferred for mammalian or eukaryotic cell expression.

Expression vectors will preferably but optionally include at least one selectable marker. Such markers include, e.g., but not limited to, methotrexate (MTX), dihydrofolate reductase (DHFR, US Pat.Nos. 4,399,216; 4,634,665; 4,656,134; 4,956,288; 5,149,636; 5,179,017, ampicillin, neomycin

(G418), mycophenolic acid, or glutamine synthetase (GS, US Pat.Nos. 5,122,464; 5,770,359; 5,827,739) resistance for eukaryotic cell culture, and tetracycline or ampicillin resistance genes for culturing in *E. coli* and other bacteria or prokaryotics (the above patents are entirely incorporated hereby by reference). Appropriate culture mediums and conditions for the above-described host cells are known in the art. Suitable vectors will be readily apparent to the skilled artisan. Introduction of a vector construct into a host cell can be effected by calcium phosphate transfection, DEAE-dextran mediated transfection, cationic lipid-mediated transfection, electroporation, transduction, infection or other known methods. Such methods are described in the art, such as Sambrook, supra, Chapters 1-4 and 16-18; Ausubel, supra, Chapters 1, 9, 13, 15, 16.

At least one CH1-deleted mimetibody or specified portion or variant of the present invention can be expressed in a modified form, such as a fusion protein, and can include not only secretion signals, but also additional heterologous functional regions. For instance, a region of additional amino acids, particularly charged amino acids, can be added to the N-terminus of a CH1-deleted mimetibody or specified portion or variant to improve stability and persistence in the host cell, during purification, or during subsequent handling and storage. Also, peptide moieties can be added to a CH1-deleted mimetibody or specified portion or variant of the present invention to facilitate purification. Such regions can be removed prior to final preparation of a CH1-deleted mimetibody or at least one fragment thereof. Such methods are described in many standard laboratory manuals, such as Sambrook, supra, Chapters 17.29-17.42 and 18.1-18.74; Ausubel, supra, Chapters 16, 17 and 18.

Those of ordinary skill in the art are knowledgeable in the numerous expression systems available for expression of a nucleic acid encoding a protein of the present invention.

Illustrative of cell cultures useful for the production of the mimetibodies, specified portions or variants thereof, are mammalian cells. Mammalian cell systems often will be in the form of monolayers of cells although mammalian cell suspensions or bioreactors can also be used. A number of suitable host cell lines capable of expressing intact glycosylated proteins have been developed in the art, and include the COS-1 (e.g., ATCC CRL 1650), COS-7 (e.g., ATCC CRL-1651), HEK293, BHK21 (e.g., ATCC CRL-10), CHO (e.g., ATCC CRL 1610) and BSC-1 (e.g., ATCC CRL-26) cell lines, hepG2 cells, P3X63Ag8.653, SP2/0-Ag14, 293 cells, HeLa cells and the like, which are readily available from, for example, American Type Culture Collection, Manassas, Va. Preferred host cells include cells of lymphoid origin such as myeloma and lymphoma cells. Particularly preferred host cells are P3X63Ag8.653 cells (ATCC Accession Number CRL-1580) and SP2/0-Ag14 cells (ATCC Accession Number CRL-1851). In a particularly preferred embodiment, the recombinant cell is a P3X63Ab8.653 or a SP2/0-Ag14 cell.

Expression vectors for these cells can include one or more of the following expression control sequences, such as, but not limited to an origin of replication; a promoter (e.g., late or early SV40

promoters, the CMV promoter (US Pat.Nos. 5,168,062; 5,385,839), an HSV tk promoter, a pgk (phosphoglycerate kinase) promoter, an EF-1 alpha promoter (US Pat.No. 5,266,491), at least one human immunoglobulin promoter; an enhancer, and/or processing information sites, such as ribosome binding sites, RNA splice sites, polyadenylation sites (e.g., an SV40 large T Ag poly A addition site), and transcriptional terminator sequences. See, e.g., Ausubel et al., supra; Sambrook, et al., supra. Other cells useful for production of nucleic acids or proteins of the present invention are known and/or available, for instance, from the American Type Culture Collection Catalogue of Cell Lines and Hybridomas (www.atcc.org) or other known or commercial sources.

When eukaryotic host cells are employed, polyadenlyation or transcription terminator sequences are typically incorporated into the vector. An example of a terminator sequence is the polyadenlyation sequence from the bovine growth hormone gene. Sequences for accurate splicing of the transcript can also be included. An example of a splicing sequence is the VP1 intron from SV40 (Sprague, et al., J. Virol. 45:773-781 (1983)). Additionally, gene sequences to control replication in the host cell can be incorporated into the vector, as known in the art.

Purification of an CH1-deleted mimetibody or specified portion or variant Thereof

A CH1-deleted mimetibody or specified portion or variant can be recovered and purified from recombinant cell cultures by well-known methods including, but not limited to, protein A purification, ammonium sulfate or ethanol precipitation, acid extraction, anion or cation exchange chromatography, phosphocellulose chromatography, hydrophobic interaction chromatography, affinity chromatography, hydroxylapatite chromatography and lectin chromatography. High performance liquid chromatography ("HPLC") can also be employed for purification. See, e.g., Colligan, Current Protocols in Immunology, or Current Protocols in Protein Science, John Wiley & Sons, NY, NY, (1997-2002), e.g., Chapters 1, 4, 6, 8, 9, 10, each entirely incorporated herein by reference.

Mimetibodies or specified portions or variants of the present invention include naturally purified products, products of chemical synthetic procedures, and products produced by recombinant techniques from a eukaryotic host, including, for example, yeast, higher plant, insect and mammalian cells. Depending upon the host employed in a recombinant production procedure, the CH1-deleted mimetibody or specified portion or variant of the present invention can be glycosylated or can be non-glycosylated, with glycosylated preferred. Such methods are described in many standard laboratory manuals, such as Sambrook, supra, Sections 17.37-17.42; Ausubel, supra, Chapters 10, 12, 13, 16, 18 and 20, Colligan, Protein Science, supra, Chapters 12-14, all entirely incorporated herein by reference.

MIMETIBODIES, SPECIFIED FRAGMENTS AND/OR VARIANTS

The isolated mimetibodies of the present invention comprise a CH1-deleted mimetibody or specified portion or variant encoded by any one of the polynucleotides of the present invention as

discussed more fully herein, or any isolated or prepared CH1-deleted mimetibody or specified portion or variant thereof.

Preferably, the CH1-deleted mimetibody or ligand-binding portion or variant binds at least one protein ligand or receptor, and, thereby provides at least one biological activity of the corresponding protein or a fragment thereof. Different therapeutically or diagnostically significant proteins are well known in the art and suitable assays or biological activities of such proteins are also well known in the art. Peptides. Any number of peptides may be used in conjunction with the present invention. Of particular interest are peptides that mimic the activity of EPO, TPO, growth hormone, G-CSF, GM-CSF, IL-1ra, leptin, CTLA4, TRAIL, TGF-α, and TGF-β. Peptide antagonists are also of interest, particularly those antagonistic to the activity of TNF, leptin, any of the interleukins (IL-1 – IL-23, etc.), and proteins involved in complement activation (e.g., C3b). Targeting peptides are also of interest, including tumor-homing peptides, membrane-transporting peptides, and the like. All of these classes of peptides may be discovered by methods described in the references cited in this specification and other references.

A particularly preferred group of peptides are those that bind to cytokine receptors. Cytokines have recently been classified according to their receptor code. See Inglot (1997), Archivum Immunologiae e Therapiae Experimentalis 45: 353-7, which is hereby incorporated entirely by reference.

Non-limiting examples of suitable peptides for this invention appear in Tables 1 through 17 below. These peptides may be prepared by methods disclosed and/or known in the art. Single letter amino acid abbreviations are used in most cases. The X in these sequences (and throughout this specification, unless specified otherwise in a particular instance) means that any of the 20 naturally occurring amino acid residues or know derivatives thereof may be present, or any know modified amino acid thereof. Any of these peptides may be linked in tandem (i.e., sequentially), with or without linkers, and a few tandemlinked examples are provided in the table. Linkers are listed as "Δ" and may be any of the linkers described herein. Tandem repeats and linkers are shown separated by dashes for clarity. Any peptide containing a cysteinyl residue may optionally be cross-linked with another Cys-containing peptide, either or both of which may be linked to a vehicle. A few crosslinked examples are provided in the table. Any peptide having more than one Cys residue may form an intrapeptide disulfide bond, as well; see, for example, EPO-mimetic peptides in Table 1. A few examples of intrapeptide disulfide-bonded peptides are specified in the table. Any of these peptides may be derivatized as described herein, and a few derivatized examples are provided in the table. For derivatives in which the carboxyl terminus may be capped with an amino group, the capping amino group is shown as $-NH_2$. For derivatives in which amino acid residues are substituted by moieties other than amino acid residues, the substitutions are denoted by a δ, which signifies any of the

moieties known in the art, e.g., as described in Bhatnagar et al. (1996), J. Med. Chem. 39: 3814-9 and Cuthbertson et al. (1997), J. Med. Chem. 40:2876-82, which are entirely incorporated by reference. The J substituent and the Z substituents (Z_5, Z_6, ... Z_{40}) are as defined in U.S. Pat. Nos. 5,608,035, 5,786,331, and 5,880,096, which are entirely incorporated herein by reference. For the EPO-mimetic sequences (Table 1), the substituents X_2 through X_{11} and the integer "n" are as defined in WO 96/40772, which is entirely incorporated by reference. The substituents "Ψ," "Θ," and "+" are as defined in Sparks et al. (1996), Proc. Natl. Acad. Sci. 93: 1540-4, which is entirely incorporated by reference. X4, X5, X6, and X7 are as defined in U.S. Pat. No. 5,773,569, which is hereby entirely incorporated by reference, except that: for integrin-binding peptides, X1, X2, X3, X4, X5, X6, X7, and X8 (Table 6), are as defined in PCT applications WO 95/14714, published June 1, 1995 and WO 97/08203, published March 6,1997, which are also entirely incorporated by reference; and for VIP-mimetic peptides (Table 9), X_1, X_1', X_1'', X_2, X_3, X_4, X_5, X_6, and Z; and the integers m and n are as defined in WO 97/40070, published October 30,1997, which is also entirely incorporated herein by reference. Xaa and Yaa below are as defined in WO 98/09985, published March 12,1998, which is entirely incorporated herein by reference. AA_1, AA_2, AB_1, AB_2, and AC are as defined in International application WO 98/53842, published December 3, 1998, which is entirely incorporated by reference. X^1, X^2, X^3, and X^4 in Table 14 only are as, defined in European application EP 0 911 393, published April 28,1999, entirely incorporated herein by reference. Residues appearing in boldface are D-amino acids, but can be optionally L-amino acids. All peptides are linked through peptide bonds unless otherwise noted. Abbreviations are listed at the end of this specification. In the "SEQID NO." column, "NR" means that no sequence listing is required for the given sequence.

Table 1-EPO-mimetic peptide sequences

Sequence/structure;	SEQID NO:
YXCXXGPXTWXCXP	1
YXCXXGPXTWXCXP-YXCXXGPXTWXCXP	2
YXCXXGPXTWXCXP-A-YXCXXGPXTWXCXP	3
YXCXXGPXTWXCXP-Δ–ε–amine) \ K /	4
YXCXXGPXTWXCXP-Δ– (α-amine)	4
GGTYSCHFGPLTWVCKPQGG	5
GGDYHCRMGPLTWVCKPLGG	6

GGVYACRMGPITWVCSPLGG	7
VGNYMCHFGPITWVCRPGGG	8
GGLYLCRFGPVTWDCGYKGG	9
GGTYSCHFGPLTWVCKPQGG-	10
GGTYSCHFGPLTWVCKPQGG -Δ-GGTYSCHFGPLTWVCKPQGG	11
GGTYSCHFGPLTWVCKPQGGSSK	12
GGTYSCHFGPLTWVCKPQGGSSK	13
GGTYSCHFGPLTWVCKPQGGSSK	14
GGTYSCHFGPLTWVCKPQGGSSK-Δ-GGTYSCHFGPLTWVCKPQGGSSK GGTYSCHFGPLTWVCKPQGGSS -Δ–ε–amine) \ K /	
GGTYSCHFGPLTWVCKPQGGSS-Δ– (α-amine)	15
GGTYSCHFGPLTWVCKPQGGSSK(-Δ-biotin)	16
$CX_4X_5GPX_6TWX_7C$	17
GGTYSCHGPLTWVCKPQGG	18
VGNYMAHMGPITWVCRPGG	19
GGPHHVYACRMGPLTWIC	20
GGTYSCHFGPLTWVCKPQ	21
GGLYACHMGPMTWVCQPLRG	22
TIAQYICYMGPETWECRPSPKA	23
YSCHFGPLTWVCK	24
YCHFGPLTWVC	25
$X_3X_4X_5GPX_6TWX_7X_8$	26
$YX_2X_3X_4X_5GPX_6TWX_7X_8$	27
$X_1YX_2X_3X_4X_5GPX_6X_7X_8X_9X_{10}X_{11}$	28
$X_1YX_2CX_4X_5GPX_6TWX_7CX_9X_{10}X_{11}$	29
GGLYLCRFGPVTWDCGYKGG	30
GGTYSCHFGPLTWVCKPQGG	31
GGDYHCRMGPLTWVCKPLGG	32
VGNYMCHFGPITWVCRPGGG	33
GGVYACRMGPITWVCSPLGG	34
VGNYMAHMGPITWVCRPGG	35
GGTYSCHFGPLTWVCKPQ	36

GGLYACHMGPMT%AIVCQPLRG	37
TIAQYICYMGPETWECRPSPKA	38
YSCHFGPLTWVCK	39
YCHFGPLTWVC	40
SCHFGPLTWVCK	41
$(AX_2)_nX_3X_4X_5GPX_6TWX_7X_8$	42

Table 2-IL-1 antagonist peptide sequences

SEQUENCE/STRUCTURE	SEQ ID NO:
$Z_{11}Z_7Z_8ZQZ_5YZ_6Z_9Z_{10}$	43
$XXQZ_5YZ_6XX$	44
$Z_7XQZ_5YZ_6XX$	45
$Z_7Z_8QZ_5YZ_6Z_9Z_{10}$	46
$Z_{11}Z_7Z_8QZ_5YZ_6Z_9Z_{10}$	47
$Z_{12}Z_{13}Z_{14}Z_{15}Z_{16}Z_{17}Z_{18}Z_{19}Z_{20}Z_{21}Z_{22}Z_{11}Z_7Z_8QZ_5YZ_6Z_9Z_{10}L$	48
$Z_{23}NZ_{24}Z_{39}Z_{25}Z_{26}Z_{27}Z_{28}Z_{29}Z_{30}Z_{40}$	49
TANVSSFEWTPYYWQPYALPL	50
SWTDYGYWQPYALPISGL	51
ETPFTWEESNAYYWQPYALPL	52
ENTYSPNWADSMYWQPYALPL	53
SVGEDHNFWTSEYWQPYALPL	54
DGYDRWRQSGERYWQPYALPL	55
FEWTPGYWQPY	56
FEWTPGYWQHY	57
FEWTPGWYQJY	58
AcFEWTPGWYQJY	59
FEVffPGWpYQJY	60
FAWTPGYWQJY	61
FEWAPGYWQJY	62
FEWVPGYWQJY	63
FEWTPGYWQJY	64
AcFEWTPGYWQJY	65
FEWTPaWYQJY	66
FEWTPSarWYQJY	67
FEWTPGYYQPY	68

FEWTPGWWQPY	69
FEWTPNYWQPY	70
FEVff PvYWQJY	71
FEWTPecGYWQJY	72
FEWTPAibYWQJY	73
FEVffSarGYWQJY	74
FEWTPGYWQPY	75
FEWTPGYWQHY	76
FEWTPGWYQJY	77
AcFEWTPGWYQJY	78
FEWTPGW-pY-QJY	79
FAWTPGYWQJY	80
FEWAPGYWQJY	81
FEWVPGYWQJY	82
FEWTPGYWQJY	83
AcFEWTPGYWQJY	84
FEWTPAWYQJY	85
FEWTPSarWYQJY	86
FEWTPGYYQPY	87
FEWTPGWWQPY	88
FEWTPNYWQPY	89
FEWTPVYWQJY	90
FEWTPecGYWQJY	91
FEWTPAibYWQJY	92
FEWTSarGYWQJY	93
FEWTPGYWQPYALPL	94
NapEWTPGYYQJY	95
YEWTPGYYQJY	96
FEWVPGYYQJY	97
FEWTPSYYQJY	99
FEWTPNYYQJY	99
TKPR	100
RKSSK	101
RKQDK	102
NRKQDK	103

RKQDKR	104
ENRKQDKRF	105
VTKFYF	106
VTKFY	107
VTDFY	108
SHLYWQPYSVQ	109
TLVYWQPYSLQT	110
RGDYWQPYSVQS	111
VHVYWQPYSVQT	112
RLVYWQPYSVQT	113
SRVWFQPYSLQS	114
NMVYWQPYSIQT	115
SVVFWQPYSVQT	116
TFVYWQPYALPL	117
TLVYWQPYSIQR	118
RLVYWQPYSVQR	119
SPVFWQPYSIQI	120
WIEWWQPYSVQS	121
SLIYWQPYSLQM	122
TRLYWQPYSVQR	123
RCDYWQPYSVQT	124
MRVFWQPYSVQN	125
KIVYWQPYSVQT	126
RHLYWQPYSVQR	127
ALVWWQPYSEQI	128
SRVWFQPYSLQS	129
WEQPYALPLE	130
QLVWWQPYSVQR	131
DLRYWQPYSVQV	132
ELVWWQPYSLQL	133
DLVWWQPYSVQW	134
NGNYWQPYSFQV	135
ELVYWQPYSIQR	136
ELMY)AIQPYSVQE	137
NLLYWQPYSMQD	138

GYEWYQPYSVQR	139
SRVWYQPYSVQR	140
LSEQYQPYSVQR	141
GGGWWQPYSVQR	142
VGRWYQPYSVQR	143
VHVYWQPYSVQR	144
QARWYQPYSVQR	145
VHVYWQPYSVQT	146
RSVYWQPYSVQR	147
TRVWFQPYSVQR	148
GRIWFQPYSVQR	149
GRVWFQPYSVQR	150
ARTWYQPYSVQR	151
ARVWWQPYSVQM	152
RLMFYQPYSVQR	153
ESMWYQPYSVQR	154
HFGWWQPYSVHM	155
ARFWWQPYSVQR	156
RLVYWQPYAPIY	157
RLVYWQPYSYQT	158
RLVYWQPYSLPI	159
RLVYWQPYSVQA	160
SRVWYQPYAKGL	161
SRVWYQPYAQGL	162
SRVWYQPYAMPL	163
SRVWYQPYSVQA	164
SRVWYQPYSLGL	165
SRVWYQPYAREL	166
SRVWYQPYSRQP	167
SRVWYQPYFVQP	168
EYEWYQPYALPL	169
IPEYWQPYALPL	170
SRIWWQPYALPL	171
DPLFWQPYALPL	172
SRQWVQPYALPL	173

IRSWWQPYALPL	174
RGYWQPYALPL	175
RLLWVQPYALPL	176
EYRWFQPYALPL	177
DAYWVQPYALPL	178
WSGYFQPYALPL	179
NIEFWQPYALPL	180
TRDWVQPYALPL	181
DSSWYQPYALPL	182
IGNWYQPYALPL	183
NLRWDQPYALPL	184
LPEFWQPYALPL	185
DSYWWQPYALPL	186
RSQYYQPYALPL	187
ARFWLQPYALPL	188
NSYFWQPYALPL	189
RFMYWQPYSVQR	190
AHLFWQPYSVQR	191
WWQPYALPL	192
YYQPYALPL	193
YFQPYALGL	194
YWYQPYALPL	195
RWWQPYATPL	196
GWYQPYALGF	197
YWYQPYALGL	198
IWYQPYAMPL	199
SNMQPYQRLS	200
TFVYWQPYAVGLPAAETACN	201
TFVYWQPYSVQMTITGKVTM	202
TFVYWQPYSSHXXVPXGFPL	203
TFVYWQPYYGNPQWAIHVRH	204
TFVYWQPYVLLELPEGAVRA	205
TFVYWQPYVDYVWPIPIAQV	206
GWYQPYVDGWR	207
RWEQPYVKDGWS	208

EWYQPYALGWAR	209
GWWQPYARGL	210
LFEQPYAKALGL	211
GWEQPYARGLAG	212
AWVQPYATPLDE	213
MWYQPYSSQPAE	214
GWTQPYSQQGEV	215
DWFQPYSIQSDE	216
PWIQPYARGFG	217
RPLYWQPYSVQV	218
TLIYWQPYSVQI	219
RFDYWQPYSDQT	220
WHQFVQPYALPL	221
EWDSVYWQPYSVQTLLR	223
WEQNVYWQPYSVQSFAD	224
SDVVYWQPYSVQSLEM	225
YYDGVYWQPYSVQVMPA	226
SDIWYQPYALPL	227
QRIWWQPYALPL	228
SRIWWQPYALPL	229
RSLYWQPYALPL	230
TIIWEQPYALPL	231
WETWYQPYALPL	232
SYDWEQPYALPL	233
SRIWCQPYALPL	234
EIMFWQPYALPL	235
DYVWQQPYALPL	236
MDLLVQWYQPYALPL	237
GSKVILWYQPYALPL	238
RQGANIWYQPYALPL	239
GGGDEPWYQPYALPL	240
SQLERTWYQPYALPL	241
ETWVREWYQPYALPL	242
KKGSTQWYQPYALPL	243
LQARMNWYQPYALPL	244

EPRSQKWYQPYALPL	245
VKQKWRWYQPYALPL	246
LRRHDVWYQPYALPL	247
RSTASIWYQPYALPL	248
ESKEDQWYQPYALPL	249
EGLTMKWYQPYALPL	250
EGSREGWYQPYALPL	251
VIEWWQPYALPL	252
VWYWEQPYALPL	253
ASEWWQPYALPL	254
FYEWWQPYALPL	255
EGWWVQPYALPL	256
WGEWLQPYALPL	257
DYVWEQPYALPL	258
AHTWWQPYALPL	259
FIEWFQPYALPL	260
WLAWEQPYALPL	261
VMEWWQPYALPL	262
ERMWQPYALPL	263
NXXWXXPYALPL	264
WGNWYQPYALPL	265
TLYWEQPYALPL	266
VWRWEQPYALPL	267
LLWTQPYALPL	268
SRIWXX PYALPL	269
SDIWYQPYALPL	270
WGYYXX PYALPL	271
TSGWYQPYALPL	272
VHPYXXPYALPL	273
EHSYFQPYALPL	274
XXIWYQPYALPL	275
AQLHSQPYALPL	276
WANWFQPYALPL	277
SRLYSQPYALPL	278
GVTFSQPYALPL	279

SIVWSQPYALPL	280
SRDLVQPYALPL	281
HWGHVYWQPYSVQDDLG	282
SWHSVYWQPYSVQSVPE	283
WRDSVYWQPYSVQPESA	284
TWDAVYWQPYSVQKWLD	285
TPPWVYWQPYSVQSLDP	286
YWSSVYWQPYSVQSVHS	287
YWYQPYALGL	288
YWYQPYALPL	289
EWIQPYATGL	290
NWEQPYAKPL	291
AFYQPYALPL	292
FLYQPYALPL	293
VCKQPYLEWC	294
ETPFTWEESNAYYWQPYALPL	295
QGWLTWQDSVDMYWQPYALPL	296
FSEAGYTWPENTYWQPYALPL	297
TESPGGLDWAKIYWQPYALPL	298
DGYDRWRQSGERYWQPYALPL	299
TANVSSFEWTPGYWQPYALPL	300
SVGEDHNFWTSE YWQPYALPL	301
MNDQTSEVSTFPYWQPYALPL	302
SWSEAFEQPRNLYWQPYALPL	303
QYAEPSALNDWGYWQPYALPL	304
NGDWATADWSNYYWQPYALPL	305
THDEHIYWQPYALPL	306
MLEKTYTTWTPG YWQPYALPL	307
WSDPLTRDADLYWQPYALPL	308
SDAFTTQDSQAMYWQPYALPL	309
GDDAAWRTDSLTYWQPYALPL	310
AIIRQLYRWSEMYWQPYALPL	311
ENTYSPNWADSMYWQPYALPL	312
MNDQTSEVSTFPYWQPYALPL	313
SVGEDHNFWTSEYWQPYALPL	314

QTPFTWEESNAYYWQPYALPL	315
ENPFTWQESNAYYWQPYALPL	316
VTPFTWEDSNVF YWQPYALPL	317
QIPFTWEQSNAYYWQPYALPL	318
QAPLTWQESAAYYWQPYALPL	319
EPTFTWEESKAT YWQPYALPL	320
TTTLTWEESNAYYWQPYALPL	321
ESPLTWEESSALYWQPYALPL	322
ETPLTWEESNAYYWQPYALPL	323
EATFTWAESNAYYWQPYALPL	324
EALFTWKESTAYYWQPYALPL	325
STP-TWEESNAYYWQPYALPL	326
ETPFTWEESNAYYWQPYALPL	327
KAPFTWEESQAYYWQPYALPL	328
STSFTWEESNAYYWQPYALPL	329
DSTFTWEESNAYYWQPYALPL	330
YIPFTWEESNAYYWQPYALPL	331
QTAFTWEESNAYYWQPYALPL	332
ETLFTWEESNAT YWQPYALPL	333
VSSFTWEESNAYYWQPYALPL	334
QPYALPL	335
Py-1-NapPYQJYALPL	336
TANVSSFEWTPG YWQPYALPL	337
FEWTPGYWQPYALPL	338
FEWTPGYWQJYALPL	339
FEWTPGYYQJYALPL	340
ETPFTWEESNAYYWQPYALPL	341
FTWEESNAYYWQJYALPL	342
ADVLYWQPYAPVTLWV	343
GDVAEYWQPYALPLTSL	344
SWTDYGYWQPYALPISGL	345
FEWTPGYWQPYALPL	346
FEWTPGYWQJYALPL	347
FEWTPGWYQPYALPL	348
FEWTPGWYQJYALPL	349

FEWTPGYYQPYALPL	350
FEWTPGYYQJYALPL	351
TANVSSFEWTPGYWQPYALPL	352
SWTDYGYWQPYALPISGL	353
ETPFTWEESNAWAIQPYALPL	354
ENTYSPNWADSMYWQPYALPL	355
SVGEDHNFWTSEYWQPYALPL	356
DGYDRWRQSGERYWQPYALPL	357
FEWTPGYWQPYALPL	358
FEWTPGYWQPY	359
FEWTPGYWQJY	360
EWTPGYWQPY	361
FEWTPGWYQJY	362
AEWTPGYWQJY	363
FAWTPGYWQJY	364
FEATPGYWQJY	365
FEWAPGYWQJY	366
FEWTAGYWQJY	367
FEWTPAYWQJY	368
FEWTPGAWQJY	369
FEWTPGYAQJY	370
FEWTPGYWQJA	371
FEWTGGYWQJY	372
FEWTPGYWQJY	373
FEWTJGYWQJY	374
FEVff PecGYWQJY	375
FEWTPAibYWQJY	376
FEWTPSarWYQJY	377
FEWTSarGYWQJY	378
FEWTPNYWQJY	379
FEWTPVYWQJY	380
FEWTVPYWQJY	381
AcFEWTPGVVYQJY	382
AcFEVffPGYWQJY	383
INap-EVff PGYYQJY	384

YEWTPGYYQJY	385
FEWVPGYYQJY	386
FEVff PGYYQJY	387
FEVff PsYYQJY	388
FEWTPnYYQJY	389
SHLY-Nap-QPYSVQM	390
TLVY-Nap-LDPYSLQT	391
RGDY-Nap-QPYSVQS	392
NMVY-Nap-QPYSIQT	393
VYWQPYSVQ	394
VY-Nap-QPYSVQ	395
TFVYWQJYALPL	396
FEWTPGYYQJ-Bpa	397
XaaFEWTPGYYQJ-Bpa	398
FEWTPGY-Bpa-QJY	399
AeFEWTPGY-Bpa-QJY	400
FEWTPG-Bpa-YQJY	401
AcFEWTPG-Bpa-YQJY	402
AcFE-Bpa-TPGYYQJY	403
AcFE-Bpa-TPGYYQJY	404
Bpa-EWTPGYYQJY	405
AcBpa-EWTPGYYQJY	406
VYWQPYSVQ	407
RLVYWQPYSVQR	408
RLVY-Nap-QPYSVQR	409
RLDYWQPYSVQR	410
RLVWFQPYSVQR	411
RLVYWQPYSIQR	412
DNSSWYDSFLL	413
DNTAWYESFLA	414
DNTAWYENFLL	415
PAREDNTAWYDSFLIWC	416
TSEYDNTTWYEKFLASQ	417
SQIPDNTAWYQSFLLHG	418
SPFIDNTAWYENFLLTY	419

EQIYDNTAWYDHFLLSY	420
TPFIDNTAWYENFLLTY	421
TYTYDNTAWYERFLMSY	422
TMTQDNTAWYENFLLSY	423
TIDNTAWYANLVQTYPQ	424
TIDNTAWYERFLAQYPD	425
HIDNTAWYENFLLTYTP	426
SQDNTAWYENFLLSYKA	427
QIDNTAWYERFLLQYNA	428
NQDNTAWYESFLLQYNT	429
TIDNTAWYENFLLNHNL	430
HYDNTAWYERFLQQGWH	431
ETPFTWEESNAYYWQPYALPL	432
YIPFTWEESNAYYWQPYALPL	433
DGYDRWRQSGERYWQPYALPL	434
pY-INap-pY-QJYALPL	435
TANVSSFEWTPGYWQPYALPL	436
FEWTPGYWQJYALPL	437
FEWTPGYWQPYALPLSD	438
FEWTPGYYQJYALPL	439
FEWTPGYWQJY	440
AcFEVVTPGYWQJY	441
AcFEWTPGWYQJY	442
AcFEWTPGYYQJY	443
AcFEWTPaYWQJY	444
AcFEWTPaWYQJY	445
AcFEWTPaYYQJY	446
FEWTPGYYQJYALPL	447
FEWTPGYWQJYALPL	448
FEWTPGWYQJYALPL	449
TANVSSFEWTPGYWQPYALPL	450
AcFEWTPGYWQJY	451
AcFEWTPGWYQJY	452
AcFEWTPGYYQJY	453
AcFEWTPAYWQJY	454

AcFEWTPAWYQJY 455

AcFEWTPAYYQJY 456

Table 3-TPO-mimetic peptide sequences

equence/structure	SEQ-ID-NO:
EGPTLRQWLAARA	457
IEGPTLRQWLAAKA	458
IEGPTLREWLAARA	459
IEGPTLRQWLAARA-A-IEGPTLRQWLAARA	460
IEGPTLRQWLAAKA-A-IEGPTLRQWLAAKA	461
IEGPTLRQCLAARA-A-IEGPTLRQCLAARA	462
IEGPTLRQWLAARA-A-K(BrAc)-A-IEGPTLRQWLAARA	463
IEGPTLRQWLAARA-A-K(PEG)-A-IEGPTLRQWLAARA	464
IEGPTLRQCLAARA-A-IEGPTLRQWLAARA	465
IEGPTLRQCLAARA-Δ-IEGPTLRQCLAARA	466
IEGPTLRQWLAARA-A-IEGPTLRQULA/AtIA	467
VRDQIXXXL	468
TLREWL	469
GRVRDQVAGW	470
GRVKDQIAQL	471
GVRDQVSWAL	472
ESVREQVMKY	473
SVRSQISASL	474
GVRETVYRHM	475
GVREVIVMHML	476
GRVRDQIWAAL	477
AGVRDQILIWL	478
GRVRDQIMLSL	479

equence/structure	SEQ-ID-NO:
GRVRDQI$(X)_3$L	480
CTLRQWLQGC	481
CTLQEFLEGC	482
CTRTEWLHGC	483
CTLREWLHGGFC	484
CTLREWVFAGLC	485
CTLRQWLILLGMC	486
CTLAEFLASGVEQC	487
CSLQEFLSHGGYVC	488
CTLREFLDPTTAVC	489
CTLKEWLVSHEVWC	490
CTLREWL$(X)_{2-6}$C	491-495
REGPTLRQWM	496
EGPTLRQWLA	497
ERGPFWAKAC	498
REGPRCVMWM	499
CGTEGPTLSTWLDC	500
CEQDGPTLLEWLKC	501
CELVGPSLMSWLTC	502
CLTGPFVTQWLYEC	503
CRAGPTLLEWLTLC	504
CADGPTLREWISFC	505
C$(X)_{1-2}$EGPTLREWL$(X)_{1-2}$C	506-510
GGCTLREWLHGGFCGG	511
GGCADGPTLREWISFCGG	512
GNADGPTLRQWLEGRRPKN	513
LAIEGPTLRQWLHGNGRDT	514
HGRVGPTLREWKTQVATKK	515
TIKGPTLRQWLKSREHTS	516
ISDGPTLKEWLSVTRGAS	517
SIEGPTLREWLTSRTPHS	518

Table 4-G-CSF-mimetic peptide sequences

Sequence/structure	SEQ ID NO:
EEDCK	519
EEDαK	520
pGluEDαK	521
PicSDαK	522
EEDCK-Δ-EEDCK	523
EEDXK-Δ-EEDXK	524

Table 5-TNF-antagonist peptide sequences

Sequence/structure	SEQID NO:
YCFTASENHCY	525
YCFTNSENHCY	526
YCFTRSENHCY	527
FCASENHCY	528
YCASENHCY	529
FCNSENHCY	530
FCNSENRCY	531
FCNSVENRCY	532
YCSQSVSNDCF	533
FCVSNDRCY	534
YCRKELGQVCY	535
YCKEPGQCY	536
YCRKEMGCY	537
FCRKEMGCY	538
YCWSQNLCY	539
YCELSQYLCY	540
YCWSQNYCY	541
YCWSQYLCY	542
DFLPHYKNTSLGHRP	543

Table 6-Integrin-binding peptide sequences

Sequence/structure	SEQID NO:
$RX_1ETX2WX_3$	544
$RX_1ETX_2WX_3$	545
RGDGX	546
CRGDGXC	547
$CX_1X_2RLDX_3X_4C$	548
CARRLDAPC	549
CPSRLDSPC	550
$X_1X_2X_3RGDX_4X_5X_6$	551
$CX_2CRGDCX_5C$	552
CDCRGDCFC	553
CDCRGDCLC	554
CLCRGDCIC	555
$X_1X_2DDX_4X_5X_7X_8$	556
$X_1X_2X_3DDX_4X_5X_6X_7X_8$	557
CWDDGWL	558
CWDDLWWLC	559
CWDDGLMC	560
CWDDGWMC	561
CSWDDGWLC	562
CPDDLWWLC	563
NGR	NR
GSL	NR
RGD	NR
CGRECPRLCQSSC	564
CNGRCVSGCAGRC	565
CLSGSLSC	566
RGD	NR
NGR	NR
GSL	NR
NGRAHA	567
CNGRC	568
CDCRGDCFC	569
CGSLVRC	570
DLXXL	571

RTDLDSLRTYTL	572
RTDLDSLRTY	573
RTDLDSLRT	574
RTDLDSLR	575
GDLDLLKLRLTL	576
GDLHSLRQLLSR	577
RDDLHMLRLQLW	578
SSDLHALKKRYG	579
RGDLKQLSELTW	580
RGDLAALSAPPV	581

Table 7-Selectin antagonist peptide sequences

Sequence/structure	SEQ ID NO:
DITWDQLWDLMK	582
DITWDELWKIMN	583
DYTWFELWDMMQ	584
QITWAQLWNMMK	585
DMTWHDLWTLMS	586
DYSWHDLWEMMS	587
EITWDQLWEVMN	588
HVSWEQLWDIMN	589
HITWDQLWRIMT	590
RNMSWLELWEHMK	591
AEWTWDQLWHVMNPAESQ	592
HRAEWLALWEQMSP	593
KKEDWLALWRIMSV	594
ITWDQLWDLMK	595
DITWDQLWDLMK	596
DITWDQLWDLMK	597
DITWDQLWDLMK	598
CQNRYTDLVAIQNKNE	599
AENWADNEPNNKRNNED	600
RKNNKTWTWVGTKKALTNE	601
KKALTNEAENWAD	602

CQXRYTDLVAIQNKXE	603
RKXNXXWTWVGTXKXLTEE	604
AENWADGEPNNKXNXED	605
CXXXYTXLVAIQNKXE	606
RKXXXXWXWVGTXKXLTXE	607
AXNWXXXEPNNXXXED	608
XKXKTXEAXNWXX	609

Table 8-Antipathogenic peptide sequences

Sequence/structure	SEQ ID NO:
GFFALIPKIISSPLFKTLLSAVGSALSSSGGQQ	610
GFFALIPKIISSPLFKTLLSAVGSALSSSGGQE	611
GFFALIPKIISSPLFKTLLSAV	612
GFFALIPKIISSPLFKTLLSAV	613
KGFFALIPKIISSPLFKTLLSAV	614
KKGFFALIPKIISSPLFKTLLSAV	615
KKGFFALIPKIISSPLFKTLLSAV	616
GFFALIPKIIS	617
GIGAVLKVLTTGLPALISWIKRKRQQ	618
GIGAVLKVLTTGLPALISWIKRKRQQ	619
GIGAVLKVLTTGLPALISWIKRKRQQ	620
GIGAVLKVLTTGLPALISWIKR	621
AVLKVLTTGLPALISWIKR	622
KLLLLLKLLLLK	623
KLLLKLLLKLLK	624
KLLLKLKLKLLK	625
KKLLKLKLKLKK	626
KLLLKLLLKLLK	627
KLLLKLKLKLLK	628
KLLLLK	629
KLLLKLLK	630
KLLLKLKLKLLK	631
KLLLKLKLKLLK	632
KLLLKLKLKLLK	633

KAAAKAAAKAAK	634
KVVVKVVVKVVK	635
KVVVKVKVKVVK	636
KVVVKVKVKVK	637
KVVVKVKVKVVK	638
KLILKL	639
KVLHLL	640
LKLRLL	641
KPLHLL	642
KLILKLVR	643
KVFHLLHL	644
HKFRILKL	645
KPFHILHL	646
KIiIKIKIKIIK	647
KIIIKIKIKIIK	648
KIIIKIKIKIIK	649
KIPIKIKIKIPK	650
KIPIKIKIKIVK	651
RIIIRIRIRIIR	652
RIIiRIRIRIIR	653
RI[IRIRIRIIR	654
RIVIRIRIRLIR	655
RIIVRIRLRIIR	656
RIGIRLRVRIIR	657
KIVIRIRIRLIR	658
RIAVKWRLRFIK	659
KIGWKLRVRIIR	660
KKIGWLIIRVRR	661
RIVIRIRIRLIRIR	662
RIIVRIRLRIIRVR	663
RIGIRLRVRIIRRV	664
KIVIRIRARLIRIRIR	665
RIIVKIRLRIIKKIRL	666
KIGIKARVRIIRVKII	667
RIIVHIRLRIIHHIRL	668

HIGIKAHVRIIRVHII	669
RIYVKIHLRYIKKIRL	670
KIGHKARVHIIRYKII	671
RIYVKPHPRYIKKIRL	672
KPGHKARPHIIRYKII	673
KIVIRIRIRLIRIRIRKIV	674
RIIVKIRLRIIKKIRLIKK	675
KIGWKLRVRIIRVKIGRLR	676
KI.VIRIRIRLIRIRIRKIVKVKRIR	677
RFAVKIRLRIIKKIRLIKKIRKRVIK	678
KAGWKLRVRIIRVKIGRLRKIGWKKRVRIK	679
RIYVKPHPRYIKKIRL	680
KPGHKARPHIIRYKII	681
KIVIRIRIRLIRIRIRKIV	682
RIIVKIRLRIIKKIRLIKK	683
RIYVSKISIYIKKIRL	684
KIVIFTRIRLTSIRIRSIV	685
KPIHKARPTIIRYKMI	686
cyclicCKGFFALIPKIISSPLFKTLLSAVC	687
CKKGFFALIPKIISSPLFKTLLSAVC	688
CKKKGFFALIPKIISSPLFKTLLSAVC	689
CyclicCRIVIRIRIRLIRIRC	690
CyclicCKPGHKARPHIIRYKIIC	691
CyclicCRFAVKIRLRIIKKIRLIKKIRKRVIKC	692
KLLLKLLL KLLKC	693
KLLLKLLLKLLK	694
KLLLKLKLKLLKC	695
KLLLKLLLKLLK	696

Table 9-VIP-mimetic peptide sequences

Sequence/structure	SEQ ID NO:
HSDAVFYDNYTR LRKQMAVKKYLN SILN	697
Me HSDAVFYDNYTR LRKQMAVKKYLN SILN	698
X_1 X_1' X_1'' X_2	699
X_3SX_4LN	700

KKYL	701
NSILN	702
KKYL	703
KKYA	704
AVKKYL	705
NSILN	706
KKYV	707
SILauN	708
KKYLNIe	709
NSYLN	710
NSIYN	711
KKYLPPNSILN	712
LauKKYL	713
CapKKYL	714
KYL	NR
KKYNIe	715
VKKYL	716
LNSILN	717
YLNSILN	718
KKYLN	719
KKYLNS	720
KKYLNSI	721
KKYLNSIL	722
KKYL	723
KKYDA	724
AVKKYL	725
NSILN	726
KKYV	727
SILauN	728
NSYLN	729
NSIYN	730
KKYLNIe	731
KKYLPPNSILN	732
KKYL	733
KKYDA	734

AVKKYL	735
NSILN	736
IKKYV	737
SILauN	738
LauKKYL	739
CapKKYL	740
KYL	NR
KYL	NR
KKYNIe	741
VKKYL	742
LNSILN	743
YLNSILN	744
KKYLNIe	745
KKYLN	746
KKYLNS	747
KKYLNSI	748
KKYLNSIL	749
KKKYLD	750
cyclicCKKYLC	751
CKKYLK	752
KKYA	753
WWTDTGLW	754
WWTDDGLW	755
WWDTRGLWVWTI	756
FWGNDGIWLESG	757
DWDQFGLWRGAA	758
RWDDNGLWVVVL	759
SGMWSHYGIWMG	760
GGRWDQAGLWVA	761
KLWSEQGIWMGE	762
CWSMHGLWLC	763
GCWDNTGIWVPC	764
DWDTRGLWVY	765
SLWDENGAWI	766
KWDDRGLWMH	767

QAWNERGLWT	768
QWDTRGLWVA	769
WNVHGIWQE	770
SWDTRGLWVE	771
DWDTRGLWVA	772
SWGRDGLWIE	773
EWTDNGLWAL	774
SWDEKGLWSA	775
SWDSSGLWMD	776

Table 10-Mdm/hdm antagonist peptide sequences

Sequence/structure	SEQID NO:
TFSDLW	777
QETFSDLWKLLP	778
QPTFSDLWKLLP	779
QETFSDYWKLLP	780
QPTFSDYWKLLP	781
MPRFMDYWEGLN	782
VQNFIDYWTQQF	783
TGPAFTHYWATF	784
IDRAPTFRDHWFALV	785
PRPALVFADYWETLY	786
PAFSRFWSDLSAGAH	787
PAFSRFWSKLSAGAH	788
PXFXDYWXXL	789
QETFSDLWKLLP	790
QPTFSDLWKLLP	791
QETFSDYWKLLP	792
QPTFSDYWKLLP	793

Table 11-Calmodulin antagonist peptide sequences

Sequence/structure	SEQ ID NO:
SCVKWGKKEFCGS	794
SCWKYWGKECGS	795

SCYEWGKLRWCGS	796
SCLRWGKWSNCGS	797
SCWRWGKYQICGS	798
SCVSWGALKLCGS	799
SCIRWGQNTFCGS	800
SCWQWGNLKICGS	801
SCVRWGQLSICGS	802
LKKFNARRKLKGAILTTMLAK	803
RRWKKNFIAVSAANRFKK	804
RKWQKTGHAVRAIGRLSS	805
INLKALAALAKKIL	806
KIWSILAPLGTTLVKLVA	807
LKKLLKLLKKLLKL	808
LKWKKLLKLLKKLLKKLL	809
AEWPSLTEIKTLSHFSV	810
AEWPSPTRVISTTYFGS	811
AELAHWPPVKTVLRSFT	812
AEGSWLQLLNLMKQMNN	813
AEWPSLTEIK	814

Table 12-Mast cell antagonists/Mast cell protease inhibitor peptide sequences

Sequence/structure	SEQ ID NO:
SGSGVLKRPLPILPVTR	815
RWLSSRPLPPLPLPPRT	816
GSGSYDTLALPSLPLHPMSS	817
GSGSYDTRALPSLPLHPMSS	818
GSGSSGVTMYPKLPPHWSMA	819
GSGSSGVRMYPKLPPHWSMA	820
GSGSSSMRMVPTIPGSAKHG	821
RNR	NR
QT	NR
RQK	NR
NRQ	NR
RQK	NR

RNRQKT	822
RNRQ	823
RNRQK	824
NRQKT	825
RQKT	826

Table 13-SH3 antagonist peptide sequences

Sequence/structure	SEQ ID NO:
RPLPPLP	827
RELPPLP	828
SPLPPLP	829
GPLPPLP	830
RPLPIPP	831
RPLPIPP	832
RRLPPTP	834
RQLPPTP	835
RPLPSRP	836
RPLPTRP	837
SRLPPLP	838
RALPSPP	839
RRLPRTP	840
RPVPPIT	841
ILAPPVP	842
RPLPMLP	843
RPLPILP	844
RPLPSLP	845
RPLPSLP	846
RPLPMIP	847
RPLPLIP	848
RPLPPTP	849
RSLPPLP	850
RPQPPPP	851
RQLPIPP	852
XXXRPLPPLPXP	853

XXXRPLPPIPXX	854
XXXRPLPPLPXX	855
RXXRPLPPLPXP	856
RXXRPLPPLPPP	857
PPPYPPPPIPXX	858
PPPYPPPPVPXX	859
LXXRPLPXTP	860
ΨXXRPLPXLP	861
PPXΘXPPPΨP	862
+PPΨPXKPXWL	863
RPXΨPΨR+SXP	864
PPVPPRPXXTL	865
ΨPΨLPΨK	866
+ΘDXPLPXLP	867

Table 14-Somatostatin or cortistatin mimetic peptide sequences

Sequence/structure	SEQID NO:
X^1X^2 -Asn-Phe-Phe-Trp-Lys-Thr-Phe-X^3-Ser-X^4	868
Asp Arg Met Pro Cys Arg Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys Lys	869
Met Pro Cys Arg Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys Lys	870
Cys Arg Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys Lys	871
Asp Arg Met Pro_Cys Arg Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys	872
Met Pro Cys Arg Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys	873
Cys Arg Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys	874
Asp Arg Met Pro Cys Lys Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys	875
Met Pro Cys Lys Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys Lys	876
Cys Lys Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys Lys	877
Asp Arg Met Pro Cys Lys Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys	878
Met Pro Cys Lys Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys	879
Cys Lys Asn Phe Phe Trp Lys Thr Phe Ser Ser Cys	880
Asp Arg Met Pro Cys Arg Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys Lys	881
Met Pro Cys Arg Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys Lys	882
Cys Arg Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys Lys	883
Asp Arg Met Pro Cys Arg Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys	884

Met Pro Cys Arg Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys	885
Cys Arg Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys	886
Asp Arg Met Pro Cys Lys Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys Lys	887
Met Pro Cys Lys Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys Lys	889
Cys Lys Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys Lys	890
Asp Arg Met Pro Cys Lys Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys	891
Met Pro Cys Lys Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys	892
Cys Lys Asn Phe Phe Trp Lys Thr Phe Thr Ser Cys	893

Table 15-UKR antagonist peptide sequences

Sequence/structure	SEQID NO:
AEPMPHSLNFSQYLWYT	894
AEHTYSSLWDTYSPLAF	895
AELDLWMRHYPLSFSNR	896
AESSLWTRYAWPSMPSY	897
AEWHPGLSFGSYLWSKT	898
AEPALLNWSFFFNPGLH	899
AEWSFYNLHLPEPQTIF	900
AEPLDLWSLYSLPPLAM	901
AEPTLWQLYQFPLRLSG	902
AEISFSELMWLRSTPAF	903
AELSEADLWTTWFGMGS	904
AESSLWRIFSPSALMMS	905
AESLPTLTSILWGKESV	906
AETLFMDLWHDKHILLT	907
AEILNFPLWHEPLWSTE	908
AESQTGTLNTLFWNTLR	909
AEPVYQYELDSYLRSYY	910
AELDLSTFYDIQYLLRT	911
AEFFKLGPNGYVYLHSA	912
FKLXXXGYVYL	913
AESTYHHLSLGYMYTLN	914
YHXLXXGYMYT	915

Table 16-Macrophage and/or T-cell inhibiting peptide sequences

Sequence/structure	SEQID NO:
Xaa-Yaa-Arg	NR
Arg-Yaa-Xaa	NR
Xaa-Arg-Yaa	NR
Yaa-Arg-Xaa	NR
Ala-Arg	NR
Arg-Arg	NR
Asn-Arg	NR
Asp-Arg	NR
Cys-Arg	NR
GIn-Arg	NR
Glu-Arg	NR
Gly-Arg	NR
His-Arg	NR
Ile-Arg	NR
Leu-Arg	NR
Lys-Arg	NR
Met-Arg	NR
Phe-Arg	NR
Ser-Arg	NR
Thr-Arg	NR
Trp-Arg	NR
Tyr-Arg	NR
Val-Arg	NR
Ala-Glu-Arg	NR
Arg-Glu-Arg	NR
Asn-Glu-Arg	NR
Asp-Glu-Arg	NR
Cys-Glu-Arg	NR
Gln-Glu-Arg	NR
Glu-Glu-Arg	NR
Gly-Glu-Arg	NR
His-Glu-Arg	NR

Ile-Glu-Arg	NR
Leu-Glu-Arg	NR
Lys-Glu-Arg	NR
Met-Glu-Arg	NR
Phe-Glu-Arg	NR
Pro-Glu-Arg	NR
Ser-Glu-Arg	NR
Thr-Glu-Arg	NR
Trp-Glu-Arg	NR
Tyr-Glu-Arg	NR
Val-Glu-Arg	NR
Arg-Ala	NR
Arg-Asp	NR
Arg-Cys	NR
Arg-Gln	NR
Arg-Glu	NR
Arg-Gly	NR
Arg-His	NR
Arg-Ile	NR
Arg-Leu	NR
Arg-Lys	NR
Arg-Met	NR
Arg-Phe	NR
Arg-Pro	NR
Arg-Ser	NR
Arg-Thr	NR
Arg-Trp	NR
Arg-Tyr	NR
Arg-Val	NR
Arg-Glu-Ala	NR
Arg-Glu-Asn	NR
Arg-Glu-Asp	NR
Arg-Glu-Cys	NR
Arg-Glu-Gln	NR
Arg-Glu-Glu	NR

Arg-Glu-Gly	NR
Arg-Glu-His	NR
Arg-Glu-Ile	NR
Arg-Glu-Leu	NR
Arg-Glu-Lys	NR
Arg-Glu-Met	NR
Arg-Glu-Phe	NR
Arg-Glu-Pro	NR
Arg-Glu-Ser	NR
Arg-Glu-Thr	NR
Arg-Glu-Trp	NR
Arg-Glu-Tyr	NR
Arg-Glu-Val	NR
Ala-Arg-Glu	NR
Arg-Arg-Glu	NR
Asn-Arg-Glu	NR
Asp-Arg-Glu	NR
Cys-Arg-Glu	NR
Gln-Arg-Glu	NR
Glu-Arg-Glu	NR
Gly-Arg-Glu	NR
His-Arg-Glu	NR
Ile-Arg-Glu	NR
Leu-Arg-Glu	NR
Lys-Arg-Glu	NR
Met-Arg-Glu	NR
Phe-Arg-Glu	NR
Pro-Arg-Glu	NR
Ser-Arg-Glu	NR
Thr-Arg-Glu	NR
Trp-Arg-Glu	NR
Tyr-Arg-Glu	NR
Val-Arg-Glu	NR
Glu-Arg-Ala	NR
Glu-Arg-Arg	NR

Glu-Arg-Asn	NR
Glu-Arg-Asp	NR
Glu-Arg-Cys	NR
Glu-Arg-Gln	NR
Glu-Arg-Gly	NR
Glu-Arg-His	NR
Glu-Arg-Ile	NR
Glu-Arg-Leu	NR
Glu-Arg-Lys	NR
Glu-Arg-Met	NR
Glu-Arg-Phe	NR
Glu-Arg-Pro	NR
Glu-Arg-Ser	NR
Glu-Arg-Thr	NR
Glu-Arg-Trp	NR
Glu-Arg-Tyr	NR
Glu-Arg-Val	NR

Table 17-Additional Exemplary Pharmacologically Active Peptides

Sequence/Structure	SEQID NO:	Activity
VEPNCDIHVMWEWECFERL	916	VEGF-antagonist
GERWCFDGPLTWVCGEES	917	VEGF-antagonist
RGWVEICVADDNGMCVTEAQ	918	VEGF-antagonist
GWDECDVARMWEWECFAGV	919	VEGF- antagonist
GERWCFDGPRAWVCGWEI	920	VEGF- antagonist
EELWCFDGPRAWVCGYVK	921	VEGF- antagonist
RGWVEICAADDYGRCLTEAQ	922	VEGF- antagonist
RGWVEICESDVWGRCL	923	VEGF- antagonist
RGWVEICESDVWGRCL	924	VEGF- antagonist
GGNECDIARMWEWECFERL	925	VEGF- antagonist
RGWVEICAADDYGRCL	926	VEGF-antagonist
CTTHWGFTLC	927	MMP inhibitor
CLRSGXGC	928	MMP inhibitor

	CXXHWGFXXC	929	MMP inhibitor
	CXPXC	930	MMP inhibitor
	CRRHWGFEFC	931	MMP inhibitor
	STTHWGFTLS	932	MMP inhibitor
5	CSLHWGFWWC	933	CTLA4-mimetic
	GFVCSGIFAVGVGRC	934	CTLA4-mimetic
	APGVRLGCAVLGRYC	935	CTLA4-mimetic
	LLGRMK	936	Antiviral (HBV)
	ICVVQDWGHHRCTAGHMANLTSHASAI	937	C3b antagonist
10	ICVVQDWGHHRCT	938	C3b antagonist
	CVVQDWGHHAC	939	C3b antagonist
	STGGFDDVYDWARGVSSALTTTLVATR	940	Vinculin-binding
	STGGFDDVYDWARRVSSALTTTLVATR	941	Vinculin-binding
	SRGVNFSEWLYDMSAAMKEASNVFPSRRSR	942	Vinculin-binding
15	SSQNWDMEAGVEDLTAAMLGLLSTIHSSSR	943	Vinculin-binding
	SSPSLYTQFLVNYESAATRIQDLLIASRPSR	944	Vinculin-binding
	SUGMIDILLGAILQRAADATRTSIPIPSLQNSIR	945	Vinculin-binding
	DVYTKKELIECARRVSEK	946	Vinculin-binding
	EKGSYYPGSGIAQFHIDYNNVS	947	C4BP-binding
20	SGIAQFHIDYNNVSSAEGWHVN	948	C41BP-binding
	LVTVEKGSYYPGSGIAQFHIDYNNVSSAEGWHVN	949	4BP-binding
	SGIAQFHIDYNNVS	950	C4BP-binding
	LLGRMK	951	anti-HBV
	ALLGRMKG	952	anti-HBV
25	LDPAFIR	953	anti-HBV
	CXXRGDC	954	Inhibition of platelet aggrepation
	RPLPPLP	955	Src antagonist
	PPVPPR	956	Src antagonist
	XFXDXWXXLXX	957	Anti-cancer
30	KACRRLFGPVDSEQLSRDCD	958	pl 6-mimetic
	RERWNFDFVTETPLEGDFAW	959	pl 6-mimetic
	KRRQTSMTDFYHSKRRLIFS	960	pl 6-mimetic
	TSMTDFYHSKRRLIFSKRKP	961	pl 6-mimetic
	RRLIF	962	p16-mimetic
35	KRRQTSATDFYHSKRRLIFSRQIKIWFQNRRMKWKK	963	p16-mimetic

KRRLIFSKRQIKIWFQNRRMKWKK	964	pl 6-mimetic
Asn Gin Gly Arg His Phe Cys Gly Gly Ala Leu Ile His Ala Arq Phe Val Met Thr Ala Ala Ser Cys Phe Gln	965	CAP37 mimetic/LPs bindin
Arg His Phe Cys Gly Gly Ala Leu Ile His Ala Arg Phe Val Met Thr Ala Ala Ser Cys	499	CAP37 mimetic/LPS binding
Gly Thr Arg Cys Gin Val Ala Gly Trp Gly Ser Gln Arg Ser Gly Gly Arg Leu Ser Arg Phe Pro Arg Phe Val Asn Val	966	CAP37 mimetic/LPS binding
WHWRHRIPLQLAAGR	967	carbohydrate (GID1 alpha) mimetic
LKTPRV	968	I32GPI Ab binding
NTLKTPRV	969	I32GPI Ab binding
NTLKTPRVGGC	970	02GPI Ab binding
KDKATF	971	02GPI Ab binding
KDKATFGCHD	972	P2GPl Ab binding
KDKATFGCHDGC	973	02GPI Ab bindinq
TLRVYK	974	02GPI Ab binding
ATLRVYKG	975	02GPI Ab binding
CATLRVYKGG	976	132GPI Ab binding
INLKALAALAKKIL	977	Membrane transporting
GWT	NR	Membrane transporting
GWTLNSAGYLLG	978	Membrane transporting
GWTLNSAGYLLGKINLKALAALAKKIL	979	Membrane transporting

The present invention is also particularly useful with peptides having activity in treatment of: a VEGF related condition, e.g., but not limited to, cancer, wherein the peptide is a VEGF-mimetic or a VEGF receptor antagonist, a HER2 agonist or antagonist, a CD20 antagonist and the like; asthma, wherein the protein of interest is a CKR3 antagonist, an IL-5 receptor antagonist, and the like; thrombosis, wherein the protein of interest is a GPIIb antagonist, a GPIIIa. antagonist, and the like; autoimmune diseases and other conditions involving immune modulation, wherein the protein of interest is an IL-2 receptor antagonist, a CD40 agonist or antagonist, a CD40L agonist or antagonist, a thymopoietin mimetic and the like.

For example, EPO biological activities are well known in the art. See, e.g., Anagnostou A et al Erythropoietin has a mitogenic and positive chemotactic effect on endothelial cells. Proceedings of the National Academy of Science (USA) 87: 5978-82 (1990); Fandrey J and Jelkman WE Interleukin 1 and tumor necrosis factor-alpha inhibit erythropoietin production in vitro. Annals of the New York Academy

of Science 628: 250-5 (1991); Geissler K et al Recombinant human erythropoietin: A multipotential hemopoietic growth factor in vivo and in vitro. Contrib. Nephrol. 87: 1-10 (1990); Gregory CJ Erythropoietin sensitivity as a differentiation marker in the hemopoietic system. Studies of three erythropoietic colony responses in culture. Journal of Cellular Physiology 89: 289-301 (1976); Jelkman W et al Monokines inhibiting erythropoietin production in human hepatoma cultures and in isolated perfused rat kidneys. Life Sci. 50: 301-8 (1992); Kimata H et al Human recombinant erythropoietin directly stimulates B cell immunoglobulin production and proliferation in serum-free medium. Clinical and Experimental Immunology 85: 151-6 (1991); Kimata H et al Erythropoietin enhances immunoglobulin production and proliferation by human plasma cells in a serum-free medium. Clin. Immunology Immunopathol. 59: 495-501 (1991); Kimata H et al Effect of recombinant human erythropoietin on human IgE production in vitro Clinical and Experimental Immunology 83: 483-7 (1991); Koury MJ and Bondurant MC Erythropoietin retards DNA breakdown and prevents programmed cell death in erythroid progenitor cells. Science 248: 378-81 (1990); Lim VS et al Effect of recombinant human erythropoietin on renal function in humans. Kidney International 37: 131-6 (1990); Mitjavila MT et al Autocrine stimulation by erythropoietin and autonomous growth of human erythroid leukemic cells in vitro. Journal of Clinical Investigation 88: 789-97 (1991); Andre M et al Performance of an immunoradiometric assay of erythropoietin and results for specimens from anemic and polycythemic patients. Clinical Chemistry 38: 758-63 (1992); Hankins WD et al Erythropoietin-dependent and erythropoietin-producing cell lines. Implications for research and for leukemia therapy. Annals of the New York Academy of Science 554: 21-8 (1989); Kendall RGT et al Storage and preparation of samples for erythropoietin radioimmunoassay. Clin. Lab. Haematology 13: 189-96 (1991); Krumvieh D et al Comparison of relevant biological assays for the determination of biological active erythropoietin. Dev. Biol. Stand. 69: 15-22 (1988); Ma DD et al Assessment of an EIA for measuring human serum erythropoietin as compared with RIA and an in-vitro bioassay. British Journal of Haematology 80: 431-6 (1992); Noe G et al A sensitive sandwich ELISA for measuring erythropoietin in human serum British Journal of Haematology 80: 285-92 (1992); Pauly JU et al Highly specific and highly sensitive enzyme immunoassays for antibodies to human interleukin 3 (IL3) and human erythropoietin (EPO) in serum. Behring Institut Mitteilungen 90: 112-25 (1991); Sakata S and Enoki Y Improved microbioassay for plasma erythropoietin based on CFU-E colony formation. Ann. Hematology 64: 224-30 (1992); Sanengen T et al Immunoreactive erythropoietin and erythropoiesis stimulating factor(s) in plasma from hypertransfused neonatal and adult mice. Studies with a radioimmunoassay and a cell culture assay for erythropoietin. Acta Physiol. Scand. 135: 11-6 (1989); Widness JA et al A sensitive and specific erythropoietin immunoprecipitation assay: application to pharmacokinetic studies. Journal of Lab. Clin. Med. 119: 285-94 (1992); for further information see also individual cell lines used in individual bioassays. Each of the above references are entirely incorporated herein by reference. EPO can be assayed by employing cell lines such as HCD57 , NFS-60 , TF-1 and

UT-7 , which respond to the factor . EPO activity can be assessed also in a Colony formation assay by determining the number of CFU-E from bone marrow cells. An alternative and entirely different detection method is RT-PCR quantitation of cytokines.

A CH1-deleted mimetibody, or specified portion or variant thereof, that partially or preferably substantially provides at least one biological activity of at least one protein or fragment, can bind the protein or fragment ligand and thereby provide at least one activity that is otherwise mediated through the binding of protein to at least one protein ligand or receptor or through other protein-dependent or mediated mechanisms. As used herein, the term "CH1-deleted mimetibody activity" refers to a CH1-deleted mimetibody that can modulate or cause at least one protein-dependent activity by about 20-10,000%, preferably by at least about 60, 70, 80, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 250, 300, 350, 400, 450, 500, 550, 600, 700, 800, 900, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000 % or more depending on the assay.

The capacity of a CH1-deleted mimetibody or specified portion or variant to provide at least one protein-dependent activity is preferably assessed by at least one suitable protein biological assay, as described herein and/or as known in the art. A human CH1-deleted mimetibody or specified portion or variant of the invention can be similar to any class (IgG, IgA, IgM, etc.) or isotype and can comprise at least a portion of a kappa or lambda light chain, wherein at least one of the LBRs is replaced by at least one LBR as described herein. In one embodiment, the human CH1-deleted mimetibody or specified portion or variant comprises an IgG heavy chain or defined fragment, for example, at least one of isotypes, IgG1, IgG2, IgG3 or IgG4. In another embodiment, the human protein human CH1-deleted mimetibody or specified portion or variant thereof comprises an IgG1 heavy chain and a IgG1 light chain.

At least one CH1-deleted mimetibody or specified portion or variant of the invention binds at least one specified ligand specific to at least one protein, subunit, fragment, portion or any combination thereof. The at least one LBR of at least one CH1-deleted mimetibody, specified portion or variant of the present invention can optionally bind at least one specified ligand epitope of the ligand. The binding epitope can comprise any combination of at least one amino acid sequence of at least 1-3 amino acids to the entire specified portion of contiguous amino acids of the sequences selected from the group consisting of a protein ligand, such as a receptor or portion thereof.

Generally, the CH1-deleted mimetibody or ligand-binding fragment of the present invention can comprise a ligand binding region (LBR) (e.g., LBR1, LBR2 and LBR3) or variant provided in at least one heavy chain variable region and at least one ligand binding region (LBR1, LBR2 and LBR3) or variant provided in at least one light chain variable region. As a non-limiting example, the CH1-deleted mimetibody or ligand-binding portion or variant can comprise at least one of the heavy chain LBR3, and/or a light chain LBR3. In a particular embodiment, the CH1-deleted mimetibody or ligand-

binding fragment can have an ligand-binding region that comprises at least a portion of at least one heavy chain LBR (i.e., LBR1, LBR2 and/or LBR3) having the amino acid sequence of the corresponding LBRs 1, 2 and/or 3). In another particular embodiment, the CH1-deleted mimetibody or ligand-binding portion or variant can have an ligand-binding region that comprises at least a portion of at least one light chain LBR (i.e., LBR1, LBR2 and/or LBR3) having the amino acid sequence of the corresponding LBRs 1, 2 and/or 3 (e.g., SEQID NOS: 10, 11, and/or 12). Such mimetibodies can be prepared by joining together the various portions (e.g., LBRs, framework) of the CH1-deleted mimetibody using known techniques, by preparing and expressing at least one (i.e., one or more) nucleic acid molecules that encode the CH1-deleted mimetibody, using known techniques of recombinant DNA technology or by using any other suitable method, such as chemical synthesis.

The CH1-deleted mimetibody can comprise at least one of a heavy or light chain variable region having a defined amino acid sequence. Mimetibodies that bind to human protein ligands or receptors and that comprise a defined heavy or light chain variable region can be prepared using suitable methods, such as phage display (Katsube, Y., *et al.*, *Int J Mol. Med*, 1(*5*):863-868 (1998)) or methods that employ transgenic animals, as known in the art and/or as described herein. The CH1-deleted mimetibody, specified portion or variant can be expressed using the encoding nucleic acid or portion thereof in a suitable host cell.

The invention also relates to mimetibodies, ligand-binding fragments, immunoglobulin chains and LBRs comprising amino acids in a sequence that is substantially the same as an amino acid sequence described herein. Preferably, such mimetibodies or ligand-binding fragments and mimetibodies comprising such chains or LBRs can bind human protein ligands with high affinity (e.g., K_D less than or equal to about 10^{-9} M). Amino acid sequences that are substantially the same as the sequences described herein include sequences comprising conservative amino acid substitutions, as well as amino acid deletions and/or insertions. A conservative amino acid substitution refers to the replacement of a first amino acid by a second amino acid that has chemical and/or physical properties (e.g, charge, structure, polarity, hydrophobicity/ hydrophilicity) that are similar to those of the first amino acid. Conservative substitutions include replacement of one amino acid by another within the following groups: lysine (K), arginine (R) and histidine (H); aspartate (D) and glutamate (E); asparagine (N), glutamine (Q), serine (S), threonine (T), tyrosine (Y), K, R, H, D and E; alanine (A), valine (V), leucine (L), isoleucine (I), proline (P), phenylalanine (F), tryptophan (W), methionine (M), cysteine (C) and glycine (G); F, W and Y; C, S and T.

Amino Acid Codes

The amino acids that make up mimetibodies or specified portions or variants of the present invention are often abbreviated. The amino acid designations can be indicated by designating the amino acid by its single letter code, its three letter code, name, or three nucleotide codon(s) as is well

understood in the art (see Alberts, B., et al., Molecular Biology of The Cell, Third Ed., Garland Publishing, Inc.,New York, 1994):

SINGLE LETTER CODE	THREE LETTER CODE	NAME	THREE NUCLEOTIDE CODON(S)
A	Ala	Alanine	GCA, GCC, GCG, GCU
C	Cys	Cysteine	UGC, UGU
D	Asp	Aspartic acid	GAC, GAU
E	Glu	Glutamic acid	GAA, GAG
F	Phe	Phenylanine	UUC, UUU
G	Gly	Glycine	GGA, GGC, GGG, GGU
H	His	Histidine	CAC, CAU
I	Ile	Isoleucine	AUA, AUC, AUU
K	Lys	Lysine	AAA, AAG
L	Leu	Leucine	UUA, UUG, CUA, CUC, CUG, CUU
M	Met	Methionine	AUG
N	Asn	Asparagine	AAC, AAU
P	Pro	Proline	CCA, CCC, CCG, CCU
Q	Gln	Glutamine	CAA, CAG
R	Arg	Arginine	AGA, AGG, CGA, CGC, CGG, CGU
S	Ser	Serine	AGC, AGU, UCA, UCC, UCG, UCU
T	Thr	Threonine	ACA, ACC, ACG, ACU
V	Val	Valine	GUA, GUC, GUG, GUU
W	Trp	Tryptophan	UGG
Y	Tyr	Tyrosine	UAC, UAU

A CH1-deleted mimetibody or specified portion or variant of the present invention can include one or more amino acid substitutions, deletions or additions, either from natural mutations or human manipulation, as specified herein.

Of course, the number of amino acid substitutions a skilled artisan would make depends on many factors, including those described above. Generally speaking, the number of amino acid substitutions, insertions or deletions for at least one of a CH1-deleted mimetibody LBR, variable, constant, light or heavy chain, or Ig will not be more than 40, 30, 20,19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1 amino acids, such as 1-30 or any range or value therein, as specified herein.

Amino acids in a CH1-deleted mimetibody or specified portion or variant of the present invention that are essential for function can be identified by methods known in the art, such as site-directed mutagenesis or alanine-scanning mutagenesis (e.g., Ausubel, supra, Chapters 8, 15; Cunningham and Wells, Science 244:1081-1085 (1989)). The latter procedure introduces single alanine mutations at every residue in the molecule. The resulting mutant molecules are then tested for biological activity, such as, but not limited to at least one protein related activity, as specified herein or

as known in the art. Sites that are critical for CH1-deleted mimetibody or specified portion or variant binding can also be identified by structural analysis such as crystallization, nuclear magnetic resonance or photoaffinity labeling (Smith, et al., J. Mol. Biol. 224:899-904 (1992) and de Vos, et al., Science 255:306-312 (1992)).

Mimetibodies or specified portions or variants of the present invention can comprise as the Pep portion of Formula (I), but are not limited to, at least one portion, sequence or combination selected from 3 to all the of at least one of SEQID NOS:1-1109. Non-limiting variants that can enhance or maintain at least one of the listed activities include, but are not limited to, any of the above polypeptides, further comprising at least one mutation corresponding to at least one substitution , insertion or deletion that does not significantly affect the suitable biological activtities or functions of said CH1-deleted mimetibody.

A(n) CH1-deleted mimetibody or specified portion or variant can further optionally comprise at least one functional portion of at least one polypeptide as Pep portion of Formula (I), at least one of 90-100% of SEQID NOS:1-1109. A CH1-deleted mimetibody can further optionally comprise an amino acid sequence for the Pep portion of Formula (I), selected from one or more of SEQID NOS:1-1109.

In one embodiment, the Pep amino acid sequence of an immunoglobulin chain, or portion thereof (e.g., comprising at least one specified variable region, LBR) has about 90-100% identity (i.e., 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100 or any range or value therein) to the corresponding amino acid sequence of the corresponding portion of at least one of SEQ ID NOS: 1-1109. Preferably, 90-100% amino acid identity (i.e., 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100 or any range or value therein) is determined using a suitable computer algorithm, as known in the art.

Mimetibodies or specified portions or variants of the present invention can comprise any number of contiguous amino acid residues from a CH1-deleted mimetibody or specified portion or variant of the present invention, wherein that number is selected from the group of integers consisting of from 10-100% of the number of contiguous residues in a CH1-deleted mimetibody. Optionally, this subsequence of contiguous amino acids is at least about 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250 or more amino acids in length, or any range or value therein. Further, the number of such subsequences can be any integer selected from the group consisting of from 1 to 20, such as at least 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, or more.

As those of skill will appreciate, the present invention includes at least one biologically active CH1-deleted mimetibody or specified portion or variant of the present invention. Biologically active mimetibodies or specified portions or variants have a specific activity at least 20%, 30%, or 40%, and preferably at least 50%, 60%, or 70%, and most preferably at least 80%, 90%, or 95%-1000% of that of the native (non-synthetic), endogenous or related and known inserted or fused protein or specified portion

or variant. Methods of assaying and quantifying measures of enzymatic activity and substrate specificity, are well known to those of skill in the art.

In another aspect, the invention relates to human mimetibodies and ligand-binding fragments, as described herein, which are modified by the covalent attachment of an organic moiety. Such modification can produce a CH1-deleted mimetibody or ligand-binding fragment with improved pharmacokinetic properties (e.g., increased *in vivo* serum half-life). The organic moiety can be a linear or branched hydrophilic polymeric group, fatty acid group, or fatty acid ester group. In particular embodiments, the hydrophilic polymeric group can have a molecular weight of about 800 to about 120,000 Daltons and can be a polyalkane glycol (e.g., polyethylene glycol (PEG), polypropylene glycol (PPG)), carbohydrate polymer, amino acid polymer or polyvinyl pyrolidone, and the fatty acid or fatty acid ester group can comprise from about eight to about forty carbon atoms.

The modified mimetibodies and ligand-binding fragments of the invention can comprise one or more organic moieties that are covalently bonded, directly or indirectly, to the CH1-deleted mimetibody or specified portion or variant. Each organic moiety that is bonded to a CH1-deleted mimetibody or ligand-binding fragment of the invention can independently be a hydrophilic polymeric group, a fatty acid group or a fatty acid ester group. As used herein, the term "fatty acid" encompasses mono-carboxylic acids and di-carboxylic acids. A "hydrophilic polymeric group," as the term is used herein, refers to an organic polymer that is more soluble in water than in octane. For example, polylysine is more soluble in water than in octane. Thus, a CH1-deleted mimetibody modified by the covalent attachment of polylysine is encompassed by the invention. Hydrophilic polymers suitable for modifying mimetibodies of the invention can be linear or branched and include, for example, polyalkane glycols (e.g., PEG, monomethoxy-polyethylene glycol (mPEG), PPG and the like), carbohydrates (e.g., dextran, cellulose, oligosaccharides, polysaccharides and the like), polymers of hydrophilic amino acids (e.g., polylysine, polyarginine, polyaspartate and the like), polyalkane oxides (e.g., polyethylene oxide, polypropylene oxide and the like) and polyvinyl pyrolidone. Preferably, the hydrophilic polymer that modifies the CH1-deleted mimetibody of the invention has a molecular weight of about 800 to about 150,000 Daltons as a separate molecular entity. For example, PEG_{2500}, PEG_{5000}, PEG_{7500}, PEG_{9000}, PEG_{10000}, PEG_{12500}, PEG_{15000}, and $PEG_{20,000}$, wherein the subscript is the average molecular weight of the polymer in Daltons, can be used.

The hydrophilic polymeric group can be substituted with one to about six alkyl, fatty acid or fatty acid ester groups. Hydrophilic polymers that are substituted with a fatty acid or fatty acid ester group can be prepared by employing suitable methods. For example, a polymer comprising an amine group can be coupled to a carboxylate of the fatty acid or fatty acid ester, and an activated carboxylate (e.g., activated with N,N-carbonyl diimidazole) on a fatty acid or fatty acid ester can be coupled to a hydroxyl group on a polymer.

Fatty acids and fatty acid esters suitable for modifying mimetibodies of the invention can be saturated or can contain one or more units of unsaturation. Fatty acids that are suitable for modifying mimetibodies of the invention include, for example, n-dodecanoate (C_{12}, laurate), n-tetradecanoate (C_{14}, myristate), n-octadecanoate (C_{18}, stearate), n-eicosanoate (C_{20}, arachidate) , n-docosanoate (C_{22}, behenate), n-triacontanoate (C_{30}), n-tetracontanoate (C_{40}), *cis*- 9-octadecanoate (C_{18}, oleate), all *cis*-5,8,11,14-eicosatetraenoate (C_{20}, arachidonate), octanedioic acid, tetradecanedioic acid, octadecanedioic acid, docosanedioic acid, and the like. Suitable fatty acid esters include mono-esters of dicarboxylic acids that comprise a linear or branched lower alkyl group. The lower alkyl group can comprise from one to about twelve, preferably one to about six, carbon atoms.

The modified human mimetibodies and ligand-binding fragments can be prepared using suitable methods, such as by reaction with one or more modifying agents. A "modifying agent" as the term is used herein, refers to a suitable organic group (e.g., hydrophilic polymer, a fatty acid, a fatty acid ester) that comprises an activating group. An "activating group" is a chemical moiety or functional group that can, under appropriate conditions, react with a second chemical group thereby forming a covalent bond between the modifying agent and the second chemical group. For example, amine-reactive activating groups include electrophilic groups such as tosylate, mesylate, halo (chloro, bromo, fluoro, iodo), N-hydroxysuccinimidyl esters (NHS), and the like. Activating groups that can react with thiols include, for example, maleimide, iodoacetyl, acrylolyl, pyridyl disulfides, 5-thiol-2-nitrobenzoic acid thiol (TNB-thiol), and the like. An aldehyde functional group can be coupled to amine- or hydrazide-containing molecules, and an azide group can react with a trivalent phosphorous group to form phosphoramidate or phosphorimide linkages. Suitable methods to introduce activating groups into molecules are known in the art (see for example, Hermanson, G. T., *Bioconjugate Techniques*, Academic Press: San Diego, CA (1996)). An activating group can be bonded directly to the organic group (e.g., hydrophilic polymer, fatty acid, fatty acid ester), or through a linker moiety, for example a divalent C_1-C_{12} group wherein one or more carbon atoms can be replaced by a heteroatom such as oxygen, nitrogen or sulfur. Suitable linker moieties include, for example, tetraethylene glycol, $-(CH_2)_3-$, $-NH-(CH_2)_6-NH-$, $-(CH_2)_2-NH-$ and $-CH_2-O-CH_2-CH_2-O-CH_2-CH_2-O-CH-NH-$. Modifying agents that comprise a linker moiety can be produced, for example, by reacting a mono-Boc-alkyldiamine (e.g., mono-Boc-ethylenediamine, mono-Boc-diaminohexane) with a fatty acid in the presence of 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide (EDC) to form an amide bond between the free amine and the fatty acid carboxylate. The Boc protecting group can be removed from the product by treatment with trifluoroacetic acid (TFA) to expose a primary amine that can be coupled to another carboxylate as described, or can be reacted with maleic anhydride and the resulting product cyclized to produce an activated maleimido derivative of the fatty acid. (See, for example, Thompson, *et al.*, WO 92/16221 the entire teachings of which are incorporated herein by reference.)

The modified mimetibodies of the invention can be produced by reacting an human CH1-deleted mimetibody or ligand-binding fragment with a modifying agent. For example, the organic moieties can be bonded to the CH1-deleted mimetibody in a non-site specific manner by employing an amine-reactive modifying agent, for example, an NHS ester of PEG. Modified human mimetibodies or ligand-binding fragments can also be prepared by reducing disulfide bonds (e.g., intra-chain disulfide bonds) of a CH1-deleted mimetibody or ligand-binding fragment. The reduced CH1-deleted mimetibody or ligand-binding fragment can then be reacted with a thiol-reactive modifying agent to produce the modified CH1-deleted mimetibody of the invention. Modified human mimetibodies and ligand-binding fragments comprising an organic moiety that is bonded to specific sites of a CH1-deleted mimetibody or specified portion or variant of the present invention can be prepared using suitable methods, such as reverse proteolysis (Fisch *et al., Bioconjugate Chem.*, 3:147-153 (1992); Werlen *et al., Bioconjugate Chem.*, 5:411-417 (1994); Kumaran *et al., Protein Sci.* 6(10):2233-2241 (1997); Itoh *et al., Bioorg. Chem.*, 24(1): 59-68 (1996); Capellas *et al., Biotechnol. Bioeng.*, 56(4):456-463 (1997)), and the methods described in Hermanson, G. T., *Bioconjugate Techniques*, Academic Press: San Diego, CA (1996).

CH1-DELETED MIMETIBODY COMPOSITIONS

The present invention also provides at least one CH1-deleted mimetibody or specified portion or variant composition comprising at least one, at least two, at least three, at least four, at least five, at least six or more mimetibodies or specified portions or variants thereof, as described herein and/or as known in the art that are provided in a non-naturally occurring composition, mixture or form. Such composition percentages are by weight, volume, concentration, molarity, or molality as liquid or dry solutions, mixtures, suspension, emulsions or colloids, as known in the art or as described herein. Such compositions can comprise 0.00001-99.9999 percent by weight, volume, concentration, molarity, or molality as liquid, gas, or dry solutions, mixtures, suspension, emulsions or colloids, as known in the art or as described herein, on any range or value therein, such as but not limited to 0.00001, 0.00003, 0.00005, 0.00009, 0.0001, 0.0003, 0.0005, 0.0009, 0.001, 0.003, 0.005, 0.009, 0.01, 0.02, 0.03, 0.05, 0.09, 0.1, 0.2, 0.3, 0.4., 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.3, 4.5, 4.6, 4.7, 4.8, 4.9, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 99.1, 99.2, 99.3, 99.4, 99.5, 99.6, 99.7, 99.8, 99.9 %. Such compositions of the present invention thus include but are not limited to 0.00001-100 mg/ml and/or 0.00001-100 mg/g.

The composition can optionally further comprise an effective amount of at least one compound or protein selected from at least one of an anti-infective drug, a cardiovascular (CV) system drug, a central nervous system (CNS) drug, an autonomic nervous system (ANS) drug, a respiratory tract drug,

a gastrointestinal (GI) tract drug, a hormonal drug, a drug for fluid or electrolyte balance, a hematologic drug, an antineoplactic, an immunomodulation drug, an ophthalmic, otic or nasal drug, a topical drug, a nutritional drug or the like. Such drugs are well known in the art, including formulations, indications, dosing and administration for each presented herein (see., e.g., Nursing 2001 Handbook of Drugs, 21st edition, Springhouse Corp., Springhouse, PA, 2001; Health Professional's Drug Guide 2001, ed., Shannon, Wilson, Stang, Prentice-Hall, Inc, Upper Saddle River, NJ; Pharmcotherapy Handbook, Wells et al., ed., Appleton & Lange, Stamford, CT, each entirely incorporated herein by reference).

The anti-infective drug can be at least one selected from amebicides or at least one antiprotozoals, anthelmintics, antifungals, antimalarials, antituberculotics or at least one antileprotics, aminoglycosides, penicillins, cephalosporins, tetracyclines, sulfonamides, fluoroquinolones, antivirals, macrolide anti-infectives, miscellaneous anti-infectives. The CV drug can be at least one selected from inotropics, antiarrhythmics, antianginals, antihypertensives, antilipemics, miscellaneous cardiovascular drugs. The CNS drug can be at least one selected from nonnarcotic analgesics or at least one selected from antipyretics, nonsteroidal anti-inflammatory drugs, narcotic or at least one opiod analgesics, sedative-hypnotics, anticonvulsants, antidepressants, antianxiety drugs, antipsychotics, central nervous system stimulants, antiparkinsonians, miscellaneous central nervous system drugs. The ANS drug can be at least one selected from cholinergics (parasympathomimetics), anticholinergics, adrenergics (sympathomimetics), adrenergic blockers (sympatholytics), skeletal muscle relaxants, neuromuscular blockers. The respiratory tract drug can be at least one selected from antihistamines, bronchodilators, expectorants or at least one antitussives, miscellaneous respiratory drugs. The GI tract drug can be at least one selected from antacids or at least one adsorbents or at least one antiflatulents, digestive enzymes or at least one gallstone solubilizers, antidiarrheals, laxatives, antiemetics, antiulcer drugs. The hormonal drug can be at least one selected from corticosteroids, androgens or at least one anabolic steroids, estrogens or at least one progestins, gonadotropins, antidiabetic drugs or at least one glucagon, thyroid hormones, thyroid hormone antagonists, pituitary hormones, parathyroid-like drugs. The drug for fluid and electrolyte balance can be at least one selected from diuretics, electrolytes or at least one replacement solutions, acidifiers or at least one alkalinizers. The hematologic drug can be at least one selected from hematinics, anticoagulants, blood derivatives, thrombolytic enzymes. The antineoplastics can be at least one selected from alkylating drugs, antimetabolites, antibiotic antineoplastics, antineoplastics that alter hormone balance, miscellaneous antineoplastics. The immunomodulation drug can be at least one selected from immunosuppressants, vaccines or at least one toxoids, antitoxins or at least one antivenins, immune serums, biological response modifiers. The ophthalmic, otic, and nasal drugs can be at least one selected from ophthalmic anti-infectives, ophthalmic anti-inflammatories, miotics, mydriatics, ophthalmic vasoconstrictors, miscellaneous ophthalmics, otics, nasal drugs. The topical drug can be at least one selected from local anti-infectives, scabicides or at

least one pediculicides, topical corticosteroids. The nutritional drug can be at least one selected from vitamins, minerals, or calorics. See, e.g., contents *of Nursing 2001 Drug Handbook, supra.*

The at least one amebicide or antiprotozoal can be at least one selected from atovaquone, chloroquine hydrochloride, chloroquine phosphate, metronidazole, metronidazole hydrochloride, pentamidine isethionate. The at least one anthelmintic can be at least one selected from mebendazole, pyrantel pamoate, thiabendazole. The at least one antifungal can be at least one selected from amphotericin B, amphotericin B cholesteryl sulfate complex, amphotericin B lipid complex, amphotericin B liposomal, fluconazole, flucytosine, griseofulvin microsize, griseofulvin ultramicrosize, itraconazole, ketoconazole, nystatin, terbinafine hydrochloride. The at least one antimalarial can be at least one selected from chloroquine hydrochloride, chloroquine phosphate, doxycycline, hydroxychloroquine sulfate, mefloquine hydrochloride, primaquine phosphate, pyrimethamine, pyrimethamine with sulfadoxine. The at least one antituberculotic or antileprotic can be at least one selected from clofazimine, cycloserine, dapsone, ethambutol hydrochloride, isoniazid, pyrazinamide, rifabutin, rifampin, rifapentine, streptomycin sulfate. The at least one aminoglycoside can be at least one selected from amikacin sulfate, gentamicin sulfate, neomycin sulfate, streptomycin sulfate, tobramycin sulfate. The at least one penicillin can be at least one selected from amoxcillin/clavulanate potassium, amoxicillin trihydrate, ampicillin, ampicillin sodium, ampicillin trihydrate, ampicillin sodium/sulbactam sodium, cloxacillin sodium, dicloxacillin sodium, mezlocillin sodium, nafcillin sodium, oxacillin sodium, penicillin G benzathine, penicillin G potassium, penicillin G procaine, penicillin G sodium, penicillin V potassium, piperacillin sodium, piperacillin sodium/tazobactam sodium, ticarcillin disodium, ticarcillin disodium/clavulanate potassium. The at least one cephalosporin can be at least one selected from at least one of cefaclor, cefadroxil, cefazolin sodium, cefdinir, cefepime hydrochloride, cefixime, cefmetazole sodium, cefonicid sodium, cefoperazone sodium, cefotaxime sodium, cefotetan disodium, cefoxitin sodium, cefpodoxime proxetil, cefprozil, ceftazidime, ceftibuten, ceftizoxime sodium, ceftriaxone sodium, cefuroxime axetil, cefuroxime sodium, cephalexin hydrochloride, cephalexin monohydrate, cephradine, loracarbef. The at least one tetracycline can be at least one selected from demeclocycline hydrochloride, doxycycline calcium, doxycycline hyclate, doxycycline hydrochloride, doxycycline monohydrate, minocycline hydrochloride, tetracycline hydrochloride. The at least one sulfonamide can be at least one selected from co-trimoxazole, sulfadiazine, sulfamethoxazole, sulfisoxazole, sulfisoxazole acetyl. The at least one fluoroquinolone can be at least one selected from alatrofloxacin mesylate, ciprofloxacin, enoxacin, levofloxacin, lomefloxacin hydrochloride, nalidixic acid, norfloxacin, ofloxacin, sparfloxacin, trovafloxacin mesylate. The at least one fluoroquinolone can be at least one selected from alatrofloxacin mesylate, ciprofloxacin, enoxacin, levofloxacin, lomefloxacin hydrochloride, nalidixic acid, norfloxacin, ofloxacin, sparfloxacin, trovafloxacin mesylate. The at least one antiviral can be at least one selected

from abacavir sulfate, acyclovir sodium, amantadine hydrochloride, amprenavir, cidofovir, delavirdine mesylate, didanosine, efavirenz, famciclovir, fomivirsen sodium, foscarnet sodium, ganciclovir, indinavir sulfate, lamivudine, lamivudine/zidovudine, nelfinavir mesylate, nevirapine, oseltamivir phosphate, ribavirin, rimantadine hydrochloride, ritonavir, saquinavir, saquinavir mesylate, stavudine, valacyclovir hydrochloride, zalcitabine, zanamivir, zidovudine. The at least one macroline anti-infective can be at least one selected from azithromycin, clarithromycin, dirithromycin, erythromycin base, erythromycin estolate, erythromycin ethylsuccinate, erythromycin lactobionate, erythromycin stearate. The at least one miscellaneous anti-infective can be at least one selected from aztreonam, bacitracin, chloramphenicol sodium sucinate, clindamycin hydrochloride, clindamycin palmitate hydrochloride, clindamycin phosphate, imipenem and cilastatin sodium, meropenem, nitrofurantoin macrocrystals, nitrofurantoin microcrystals, quinupristin/dalfopristin, spectinomycin hydrochloride, trimethoprim, vancomycin hydrochloride. (See, e.g., pp. 24-214 of *Nursing 2001 Drug Handbook.*)

The at least one inotropic can be at least one selected from amrinone lactate, digoxin, milrinone lactate. The at least one antiarrhythmic can be at least one selected from adenosine, amiodarone hydrochloride, atropine sulfate, bretylium tosylate, diltiazem hydrochloride, disopyramide, disopyramide phosphate, esmolol hydrochloride, flecainide acetate, ibutilide fumarate, lidocaine hydrochloride, mexiletine hydrochloride, moricizine hydrochloride, phenytoin, phenytoin sodium, procainamide hydrochloride, propafenone hydrochloride, propranolol hydrochloride, quinidine bisulfate, quinidine gluconate, quinidine polygalacturonate, quinidine sulfate, sotalol, tocainide hydrochloride, verapamil hydrochloride. The at least one antianginal can be at least one selected from amlodipidine besylate, amyl nitrite, bepridil hydrochloride, diltiazem hydrochloride, isosorbide dinitrate, isosorbide mononitrate, nadolol, nicardipine hydrochloride, nifedipine, nitroglycerin, propranolol hydrochloride, verapamil, verapamil hydrochloride. The at least one antihypertensive can be at least one selected from acebutolol hydrochloride, amlodipine besylate, atenolol, benazepril hydrochloride, betaxolol hydrochloride, bisoprolol fumarate, candesartan cilexetil, captopril, carteolol hydrochloride, carvedilol, clonidine, clonidine hydrochloride, diazoxide, diltiazem hydrochloride, doxazosin mesylate, enalaprilat, enalapril maleate, eprosartan mesylate, felodipine, fenoldopam mesylate, fosinopril sodium, guanabenz acetate, guanadrel sulfate, guanfacine hydrochloride, hydralazine hydrochloride, irbesartan, isradipine, labetalol hydrchloride, lisinopril, losartan potassium, methyldopa, methyldopate hydrochloride, metoprolol succinate, metoprolol tartrate, minoxidil, moexipril hydrochloride, nadolol, nicardipine hydrochloride, nifedipine, nisoldipine, nitroprusside sodium, penbutolol sulfate, perindopril erbumine, phentolamine mesylate, pindolol, prazosin hydrochloride, propranolol hydrochloride, quinapril hydrochloride, ramipril, telmisartan, terazosin hydrochloride, timolol maleate, trandolapril, valsartan, verapamil hydrochloride The at least one antilipemic can be at least one selected from atorvastatin calcium, cerivastatin sodium, cholestyramine,

colestipol hydrochloride, fenofibrate (micronized), fluvastatin sodium, gemfibrozil, lovastatin, niacin, pravastatin sodium, simvastatin. The at least one miscellaneous CV drug can be at least one selected from abciximab, alprostadil, arbutamine hydrochloride, cilostazol, clopidogrel bisulfate, dipyridamole, eptifibatide, midodrine hydrochloride, pentoxifylline, ticlopidine hydrochloride, tirofiban hydrochloride. (See, e.g., pp. 215-336 of *Nursing 2001 Drug Handbook.*)

The at least one nonnarcotic analgesic or antipyretic can be at least one selected from acetaminophen, aspirin, choline magnesium trisalicylate, diflunisal, magnesium salicylate. The at least one nonsteroidal anti-inflammatory drug can be at least one selected from celecoxib, diclofenac potassium, diclofenac sodium, etodolac, fenoprofen calcium, flurbiprofen, ibuprofen, indomethacin, indomethacin sodium trihydrate, ketoprofen, ketorolac tromethamine, nabumetone, naproxen, naproxen sodium, oxaprozin, piroxicam, rofecoxib, sulindac. The at least one narcotic or opiod analgesic can be at least one selected from alfentanil hydrochloride, buprenorphine hydrochloride, butorphanol tartrate, codeine phosphate, codeine sulfate, fentanyl citrate, fentanyl transdermal system, fentanyl transmucosal, hydromorphone hydrochloride, meperidine hydrochloride, methadone hydrochloride, morphine hydrochloride, morphine sulfate, morphine tartrate, nalbuphine hydrochloride, oxycodone hydrochloride, oxycodone pectinate, oxymorphone hydrochloride, pentazocine hydrochloride, pentazocine hydrochloride and naloxone hydrochloride, pentazocine lactate, propoxyphene hydrochloride, propoxyphene napsylate, remifentanil hydrochloride, sufentanil citrate, tramadol hydrochloride. The at least one sedative-hypnotic can be at least one selected from chloral hydrate, estazolam, flurazepam hydrochloride, pentobarbital, pentobarbital sodium, phenobarbital sodium, secobarbital sodium, temazepam, triazolam, zaleplon, zolpidem tartrate. The at least one anticonvulsant can be at least one selected from acetazolamide sodium, carbamazepine, clonazepam, clorazepate dipotassium, diazepam, divalproex sodium, ethosuximde, fosphenytoin sodium, gabapentin, lamotrigine, magnesium sulfate, phenobarbital, phenobarbital sodium, phenytoin, phenytoin sodium, phenytoin sodium (extended), primidone, tiagabine hydrochloride, topiramate, valproate sodium, valproic acid. The at least one antidepressant can be at least one selected from amitriptyline hydrochloride, amitriptyline pamoate, amoxapine, bupropion hydrochloride, citalopram hydrobromide, clomipramine hydrochloride, desipramine hydrochloride, doxepin hydrochloride, fluoxetine hydrochloride, imipramine hydrochloride, imipramine pamoate, mirtazapine, nefazodone hydrochloride, nortriptyline hydrochloride, paroxetine hydrochloride, phenelzine sulfate, sertraline hydrochloride, tranylcypromine sulfate, trimipramine maleate, venlafaxine hydrochloride. The at least one antianxiety drug can be at least one selected from alprazolam, buspirone hydrochloride, chlordiazepoxide, chlordiazepoxide hydrochloride, clorazepate dipotassium, diazepam, doxepin hydrochloride, hydroxyzine embonate, hydroxyzine hydrochloride, hydroxyzine pamoate, lorazepam, mephrobamate, midazolam hydrochloride, oxazepam. The at least one antipsychotic drug can be at

least one selected from chlorpromazine hydrochloride, clozapine, fluphenazine decanoate, fluephenazine enanthate, fluphenazine hydrochloride, haloperidol, haloperidol decanoate, haloperidol lactate, loxapine hydrochloride, loxapine succinate, mesoridazine besylate, molindone hydrochloride, olanzapine, perphenazine, pimozide, prochlorperazine, quetiapine fumarate, risperidone, thioridazine hydrochloride, thiothixene, thiothixene hydrochloride, trifluoperazine hydrochloride. The at least one central nervous system stimulant can be at least one selected from amphetamine sulfate, caffeine, dextroamphetamine sulfate, doxapram hydrochloride, methamphetamine hydrochloride, methylphenidate hydrochloride, modafinil, pemoline, phentermine hydrochloride. The at least one antiparkinsonian can be at least one selected from amantadine hydrochloride, benztropine mesylate, biperiden hydrochloride, biperiden lactate, bromocriptine mesylate, carbidopa-levodopa, entacapone, levodopa, pergolide mesylate, pramipexole dihydrochloride, ropinirole hydrochloride, selegiline hydrochloride, tolcapone, trihexyphenidyl hydrochloride. The at least one miscellaneous central nervous system drug can be at least one selected from bupropion hydrochloride, donepezil hydrochloride, droperidol, fluvoxamine maleate, lithium carbonate, lithium citrate, naratriptan hydrochloride, nicotine polacrilex, nicotine transdermal system, propofol, rizatriptan benzoate, sibutramine hydrochloride monohydrate, sumatriptan succinate, tacrine hydrochloride, zolmitriptan. (See, e.g., pp. 337-530 of *Nursing 2001 Drug Handbook.*)

The at least one cholinergic (e.g., parasymathomimetic) can be at least one selected from bethanechol chloride, edrophonium chloride, neostigmine bromide, neostigmine methylsulfate, physostigmine salicylate, pyridostigmine bromide. The at least one anticholinergics can be at least one selected from atropine sulfate, dicyclomine hydrochloride, glycopyrrolate, hyoscyamine, hyoscyamine sulfate, propantheline bromide, scopolamine, scopolamine butylbromide, scopolamine hydrobromide. The at least one adrenergics (sympathomimetics) can be at least one selected from dobutamine hydrochloride, dopamine hydrochloride, metaraminol bitartrate, norepinephrine bitartrate, phenylephrine hydrochloride, pseudoephedrine hydrochloride, pseudoephedrine sulfate. The at least one adrenergic blocker (sympatholytic) can be at least one selected from dihydroergotamine mesylate, ergotamine tartrate, methysergide maleate, propranolol hydrochloride. The at least one skeletal muscle relaxant can be at least one selected from baclofen, carisoprodol, chlorzoxazone, cyclobenzaprine hydrochloride, dantrolene sodium, methocarbamol, tizanidine hydrochloride. The at least one neuromuscular blockers can be at least one selected from atracurium besylate, cisatracurium besylate, doxacurium chloride, mivacurium chloride, pancuronium bromide, pipecuronium bromide, rapacuronium bromide, rocuronium bromide, succinylcholine chloride, tubocurarine chloride, vecuronium bromide. (See, e.g., pp. 531-84 of *Nursing 2001 Drug Handbook.*)

The at least one antihistamine can be at least one selected from brompheniramine maleate, cetirizine hydrochloride, chlorpheniramine maleate, clemastine fumarate, cyproheptadine

hydrochloride, diphenhydramine hydrochloride, fexofenadine hydrochloride, loratadine, promethazine hydrochloride, promethazine theoclate, triprolidine hydrochloride. The at least one bronchodilators can be at least one selected from albuterol, albuterol sulfate, aminophylline, atropine sulfate, ephedrine sulfate, epinephrine, epinephrine bitartrate, epinephrine hydrochloride, ipratropium bromide, isoproterenol, isoproterenol hydrochloride, isoproterenol sulfate, levalbuterol hydrochloride, metaproterenol sulfate, oxtriphylline, pirbuterol acetate, salmeterol xinafoate, terbutaline sulfate, theophylline. The at least one expectorants or antitussives can be at least one selected from benzonatate, codeine phosphate, codeine sulfate, dextramethorphan hydrobromide, diphenhydramine hydrochloride, guaifenesin, hydromorphone hydrochloride. The at least one miscellaneous respiratory drug can be at least one selected from acetylcysteine, beclomethasone dipropionate, beractant, budesonide, calfactant, cromolyn sodium, dornase alfa, epoprostenol sodium, flunisolide, fluticasone propionate, montelukast sodium, nedocromil sodium, palivizumab, triamcinolone acetonide, zafirlukast, zileuton. (See, e.g., pp. 585-642 of *Nursing 2001 Drug Handbook.*)

The at least one antacid, adsorbents, or antiflatulents can be at least one selected from aluminum carbonate, aluminum hydroxide, calcium carbonate, magaldrate, magnesium hydroxide, magnesium oxide, simethicone, sodium bicarbonate. The at least one digestive enymes or gallstone solubilizers can be at least one selected from pancreatin, pancrelipase, ursodiol. The at least one antidiarrheal can be at least one selected from attapulgite, bismuth subsalicylate, calcium polycarbophil, diphenoxylate hydrochloride or atropine sulfate, loperamide, octreotide acetate, opium tincture, opium tincure (camphorated). The at least one laxative can be at least one selected from bisocodyl, calcium polycarbophil, cascara sagrada, cascara sagrada aromatic fluidextract, cascara sagrada fluidextract, castor oil, docusate calcium, docusate sodium, glycerin, lactulose, magnesium citrate, magnesium hydroxide, magnesium sulfate, methylcellulose, mineral oil, polyethylene glycol or electrolyte solution, psyllium, senna, sodium phosphates. The at least one antiemetic can be at least one selected from chlorpromazine hydrochloride, dimenhydrinate, dolasetron mesylate, dronabinol, granisetron hydrochloride, meclizine hydrochloride, metoclopramide hydrochloride, ondansetron hydrochloride, perphenazine, prochlorperazine, prochlorperazine edisylate, prochlorperazine maleate, promethazine hydrochloride, scopolamine, thiethylperazine maleate, trimethobenzamide hydrochloride. The at least one antiulcer drug can be at least one selected from cimetidine, cimetidine hydrochloride, famotidine, lansoprazole, misoprostol, nizatidine, omeprazole, rabeprozole sodium, rantidine bismuth citrate, ranitidine hydrochloride, sucralfate. (See, e.g., pp. 643-95 of *Nursing 2001 Drug Handbook.*)

The at least one coricosteroids can be at least one selected from betamethasone, betamethasone acetate or betamethasone sodium phosphate, betamethasone sodium phosphate, cortisone acetate, dexamethasone, dexamethasone acetate, dexamethasone sodium phosphate, fludrocortisone acetate, hydrocortisone, hydrocortisone acetate, hydrocortisone cypionate, hydrocortisone sodium phosphate,

hydrocortisone sodium succinate, methylprednisolone, methylprednisolone acetate, methylprednisolone sodium succinate, prednisolone, prednisolone acetate, prednisolone sodium phosphate, prednisolone tebutate, prednisone, triamcinolone, triamcinolone acetonide, triamcinolone diacetate. The at least one androgen or anabolic steroids can be at least one selected from danazol, fluoxymesterone, methyltestosterone, nandrolone decanoate, nandrolone phenpropionate, testosterone, testosterone cypionate, testosterone enanthate, testosterone propionate, testosterone transdermal system. The at least one estrogen or progestin can be at least one selected from esterified estrogens, estradiol, estradiol cypionate, estradiol/norethindrone acetate transdermal system, estradiol valerate, estrogens (conjugated), estropipate, ethinyl estradiol, ethinyl estradiol and desogestrel, ethinyl estradiol and ethynodiol diacetate, ethinyl estradiol and desogestrel, ethinyl estradiol and ethynodiol diacetate, ethinyl estradiol and levonorgestrel, ethinyl estradiol and norethindrone, ethinyl estradiol and norethindrone acetate, ethinyl estradiol and norgestimate, ethinyl estradiol and norgestrel, ethinyl estradiol and norethindrone and acetate and ferrous fumarate, levonorgestrel, medroxyprogesterone acetate, mestranol and norethindron, norethindrone, norethindrone acetate, norgestrel, progesterone. The at least one gonadroptropin can be at least one selected from ganirelix acetate, gonadoreline acetate, histrelin acetate, menotropins. The at least one antidiabetic or glucaon can be at least one selected from acarbose, chlorpropamide, glimepiride, glipizide, glucagon, glyburide, insulins, metformin hydrochloride, miglitol, pioglitazone hydrochloride, repaglinide, rosiglitazone maleate, troglitazone. The at least one thyroid hormone can be at least one selected from levothyroxine sodium, liothyronine sodium, liotrix, thyroid. The at least one thyroid hormone antagonist can be at least one selected from methimazole, potassium iodide, potassium iodide (saturated solution), propylthiouracil, radioactive iodine (sodium iodide ^{131}I), strong iodine solution. The at least one pituitary hormone can be at least one selected from corticotropin, cosyntropin, desmophressin acetate, leuprolide acetate, repository corticotropin, somatrem, somatropin, vasopressin. The at least one parathyroid-like drug can be at least one selected from calcifediol, calcitonin (human), calcitonin (salmon), calcitriol, dihydrotachysterol, etidronate disodium. (See, e.g., pp. 696-796 of *Nursing 2001 Drug Handbook*.)

The at least one diuretic can be at least one selected from acetazolamide, acetazolamide sodium, amiloride hydrochloride, bumetanide, chlorthalidone, ethacrynate sodium, ethacrynic acid, furosemide, hydrochlorothiazide, indapamide, mannitol, metolazone, spironolactone, torsemide, triamterene, urea. The at least one electrolyte or replacement solution can be at least one selected from calcium acetate, calcium carbonate, calcium chloride, calcium citrate, calcium glubionate, calcium gluceptate, calcium gluconate, calcium lactate, calcium phosphate (dibasic), calcium phosphate (tribasic), dextran (high-molecular-weight), dextran (low-molecular-weight), hetastarch, magnesium chloride, magnesium sulfate, potassium acetate, potassium bicarbonate, potassium chloride, potassium gluconate, Ringer's injection, Ringer's injection (lactated), sodium chloride. The at least one acidifier

or alkalinizer can be at least one selected from sodium bicarbonate, sodium lactate, tromethamine. (See, e.g., pp. 797-833 of *Nursing 2001 Drug Handbook.*)

The at least one hematinic can be at least one selected from ferrous fumarate, ferrous gluconate, ferrous sulfate, ferrous sulfate (dried), iron dextran, iron sorbitol, polysaccharide-iron complex, sodium ferric gluconate complex. The at least one anticoagulant can be at least one selected from ardeparin sodium, dalteparin sodium, danaparoid sodium, enoxaparin sodium, heparin calcium, heparin sodium, warfarin sodium. The at least one blood derivative can be at least one selected from albumin 5%, albumin 25%, antihemophilic factor, anti-inhibitor coagulant complex, antithrombin III (human), factor IX (human), factor IX complex, plasma protein fractions. The at least one thrombolytic enzyme can be at least one selected from alteplase, anistreplase, reteplase (recombinant), streptokinase, urokinase. (See, e.g., pp. 834-66 of *Nursing 2001 Drug Handbook.*)

The at least one alkylating drug can be at least one selected from busulfan, carboplatin, carmustine, chlorambucil, cisplatin, cyclophosphamide, ifosfamide, lomustine, mechlorethamine hydrochloride, melphalan, melphalan hydrochloride, streptozocin, temozolomide, thiotepa. The at least one antimetabolite can be at least one selected from capecitabine, cladribine, cytarabine, floxuridine, fludarabine phosphate, fluorouracil, hydroxyurea, mercaptopurine, methotrexate, methotrexate sodium, thioguanine. The at least one antibiotic antineoplastic can be at least one selected from bleomycin sulfate, dactinomycin, daunorubicin citrate liposomal, daunorubicin hydrochloride, doxorubicin hydrochloride, doxorubicin hydrochloride liposomal, epirubicin hydrochloride, idarubicin hydrochloride, mitomycin, pentostatin, plicamycin, valrubicin. The at least one antineoplastics that alter hormone balance can be at least one selected from anastrozole, bicalutamide, estramustine phosphate sodium, exemestane, flutamide, goserelin acetate, letrozole, leuprolide acetate, megestrol acetate, nilutamide, tamoxifen citrate, testolactone, toremifene citrate. The at least one miscellaneous antineoplastic can be at least one selected from asparaginase, bacillus Calmette-Guerin (BCG) (live intravesical), dacarbazine, docetaxel, etoposide, etoposide phosphate, gemcitabine hydrochloride, irinotecan hydrochloride, mitotane, mitoxantrone hydrochloride, paclitaxel, pegaspargase, porfimer sodium, procarbazine hydrochloride, rituximab, teniposide, topotecan hydrochloride, trastuzumab, tretinoin, vinblastine sulfate, vincristine sulfate, vinorelbine tartrate. (See, e.g., pp. 867-963 of *Nursing 2001 Drug Handbook.*)

The at least one immunosuppressant can be at least one selected from azathioprine, basiliximab, cyclosporine, daclizumab, lymphocyte immune globulin, muromonab-CD3, mycophenolate mofetil, mycophenolate mofetil hydrochloride, sirolimus, tacrolimus. The at least one vaccine or toxoid can be at least one selected from BCG vaccine, cholera vaccine, diphtheria and tetanus toxoids (adsorbed), diphtheria and tetanus toxoids and acellular pertussis vaccine adsorbed, diphtheria and tetanus toxoids and whole-cell pertussis vaccine, *Haemophilius* b conjugate vaccines,

hepatitis A vaccine (inactivated), hepatisis B vaccine (recombinant), influenza virus vaccine 1999-2000 trivalent types A & B (purified surface antigen), influenza virus vaccine 1999-2000 trivalent types A & B (subvirion or purified subvirion), influenza virus vaccine 1999-2000 trivalent types A & B (whole virion), Japanese encephalitis virus vaccine (inactivated), Lyme disease vaccine (recombinant OspA), measles and mumps and rubella virus vaccine (live), measles and mumps and rubella virus vaccine (live attenuated), measles virus vaccine (live attenuated), meningococcal polysaccharide vaccine, mumps virus vaccine (live), plague vaccine, pneumococcal vaccine (polyvalent), poliovirus vaccine (inactivated), poliovirus vaccine (live, oral, trivalent), rabies vaccine (adsorbed), rabies vaccine (human diploid cell), rubella and mumps virus vaccine (live), rubella virus vaccine (live, attenuated), tetanus toxoid (adsorbed), tetanus toxoid (fluid), typhoid vaccine (oral), typhoid vaccine (parenteral), typhoid Vi polysaccharide vaccine, varicella virus vaccine, yellow fever vaccine. The at least one antitoxin or antivenin can be at least one selected from black widow spider antivenin, Crotalidae antivenom (polyvalent), diphtheria antitoxin (equine), *Micrurus fulvius* antivenin). The at least one immune serum can be at least one selected from cytomegalovirus immune globulin (intraveneous), hepatitis B immune globulin (human), immune globulin intramuscular, immune globulin intravenous, rabies immune globulin (human), respiratory syncytial virus immune globulin intravenous (human), Rh_0(D) immune globulin (human), Rh_0(D) immune globulin intravenous (human), tetanus immune globulin (human), varicella-zoster immune globulin. The at least one biological response modifiers can be at least one selected from aldesleukin, epoetin alfa, filgrastim, glatiramer acetate for injection, interferon alfacon-1, interferon alfa-2a (recombinant), interferon alfa-2b (recombinant), interferon beta-1a, interferon beta-1b (recombinant), interferon gamma-1b, levamisole hydrochloride, oprelvekin, sargramostim. (See, e.g., pp. 964-1040 of *Nursing 2001 Drug Handbook.*)

The at least one ophthalmic anti-infectives can be selected form bacitracin, chloramphenicol, ciprofloxacin hydrochloride, erythromycin, gentamicin sulfate, ofloxacin 0.3%, polymyxin B sulfate, sulfacetamide sodium 10%, sulfacetamide sodium 15%, sulfacetamide sodium 30%, tobramycin, vidarabine. The at least one ophthalmic anti-inflammatories can be at least one selected from dexamethasone, dexamethasone sodium phosphate, diclofenac sodium 0.1%, fluorometholone, flurbiprofen sodium, ketorolac tromethamine, prednisolone acetate (suspension) prednisolone sodium phosphate (solution). The at least one miotic can be at least one selected from acetylocholine chloride, carbachol (intraocular), carbachol (topical), echothiophate iodide, pilocarpine, pilocarpine hydrochloride, pilocarpine nitrate. The at least one mydriatic can be at least one selected from atropine sulfate, cyclopentolate hydrochloride, epinephrine hydrochloride, epinephryl borate, homatropine hydrobromide, phenylephrine hydrochloride, scopolamine hydrobromide, tropicamide. The at least one ophthalmic vasoconstrictors can be at least one selected from naphazoline hydrochloride, oxymetazoline hydrochloride, tetrahydrozoline hydrochloride. The at least one miscellaneous

ophthalmics can be at least one selected from apraclonidine hydrochloride, betaxolol hydrochloride, brimonidine tartrate, carteolol hydrochloride, dipivefrin hydrochloride, dorzolamide hydrochloride, emedastine difumarate, fluorescein sodium, ketotifen fumarate, latanoprost, levobunolol hydrochloride, metipranolol hydrochloride, sodium chloride (hypertonic), timolol maleate. The at least one otic can be at least one selected from boric acid, carbamide peroxide, chloramphenicol, triethanolamine polypeptide oleate-condensate. The at least one nasal drug can be at least one selected from beclomethasone dipropionate, budesonide, ephedrine sulfate, epinephrine hydrochloride, flunisolide, fluticasone propionate, naphazoline hydrochloride, oxymetazoline hydrochloride, phenylephrine hydrochloride, tetrahydrozoline hydrochloride, triamcinolone acetonide, xylometazoline hydrochloride. (See, e.g., pp. 1041-97 of *Nursing 2001 Drug Handbook.*)

The at least one local anti-infectives can be at least one selected from acyclovir, amphotericin B, azelaic acid cream, bacitracin, butoconazole nitrate, clindamycin phosphate, clotrimazole, econazole nitrate, erythromycin, gentamicin sulfate, ketoconazole, mafenide acetate, metronidazole (topical), miconazole nitrate, mupirocin, naftifine hydrochloride, neomycin sulfate, nitrofurazone, nystatin, silver sulfadiazine, terbinafine hydrochloride, terconazole, tetracycline hydrochloride, tioconazole, tolnaftate. The at least one scabicide or pediculicide can be at least one selected from crotamiton, lindane, permethrin, pyrethrins. The at least one topical corticosteroid can be at least one selected from betamethasone dipropionate, betamethasone valerate, clobetasol propionate, desonide, desoximetasone, dexamethasone, dexamethasone sodium phosphate, diflorasone diacetate, fluocinolone acetonide, fluocinonide, flurandrenolide, fluticasone propionate, halcionide, hydrocortisone, hydrocortisone acetate, hydrocortisone butyrate, hydrocorisone valerate, mometasone furoate, triamcinolone acetonide. (See, e.g., pp. 1098-1136 of *Nursing 2001 Drug Handbook.*)

The at least one vitamin or mineral can be at least one selected from vitamin A, vitamin B complex, cyanocobalamin, folic acid, hydroxocobalamin, leucovorin calcium, niacin, niacinamide, pyridoxine hydrochloride, riboflavin, thiamine hydrochloride, vitamin C, vitamin D, cholecalciferol, ergocalciferol, vitamin D analogue, doxercalciferol, paricalcitol, vitamin E, vitamin K analogue, phytonadione, sodium fluoride, sodium fluoride (topical), trace elements, chromium, copper, iodine, manganese, selenium, zinc. The at least one calorics can be at least one selected from amino acid infusions (crystalline), amino acid infusions in dextrose, amino acid infusions with electrolytes, amino acid infusions with electrolytes in dextrose, amino acid infusions for hepatic failure, amino acid infusions for high metabolic stress, amino acid infusions for renal failure, dextrose, fat emulsions, medium-chain triglycerides. (See, e.g., pp. 1137-63 of *Nursing 2001 Drug Handbook.*)

CH1 deleted mimetibody antibody or polypeptide compositions of the present invention can further comprise at least one of any suitable and/or effective amount of a composition or pharmaceutical composition comprising at least one CH1 deleted mimetibody protein or antibody to a

cell, tissue, organ, animal or patient in need of such modulation, treatment or therapy, optionally further comprising at least one selected from at least one TNF antagonist (e.g., but not limited to a TNF chemical or protein antagonist, TNF monoclonal or polyclonal antibody or fragment, a soluble TNF receptor (e.g., p55, p70 or p85) or fragment, fusion polypeptides thereof, or a small molecule TNF antagonist, e.g., TNF binding protein I or II (TBP-1 or TBP-II), nerelimonmab, infliximab, enteracept, CDP-571, CDP-870, afelimomab, lenercept, and the like), an antirheumatic (e.g., methotrexate, auranofin, aurothioglucose, azathioprine, etanercept, gold sodium thiomalate, hydroxychloroquine sulfate, leflunomide, sulfasalzine), a muscle relaxant, a narcotic, a non-steroid inflammatory drug (NSAID), an analgesic, an anesthetic, a sedative, a local anethetic, a neuromuscular blocker, an antimicrobial (e.g., aminoglycoside, an antifungal, an antiparasitic, an antiviral, a carbapenem, cephalosporin, a flurorquinolone, a macrolide, a penicillin, a sulfonamide, a tetracycline, another antimicrobial), an antipsoriatic, a corticosteriod, an anabolic steroid, a diabetes related agent, a mineral, a nutritional, a thyroid agent, a vitamin, a calcium related hormone, an antidiarrheal, an antitussive, an antiemetic, an antiulcer, a laxative, an anticoagulant, an erythropieitin (e.g., epoetin alpha), a filgrastim (e.g., G-CSF, Neupogen), a sargramostim (GM-CSF, Leukine), an immunization, an immunoglobulin, an immunosuppressive (e.g., basiliximab, cyclosporine, daclizumab), a growth hormone, a hormone replacement drug, an estrogen receptor modulator, a mydriatic, a cycloplegic, an alkylating agent, an antimetabolite, a mitotic inhibitor, a radiopharmaceutical, an antidepressant, antimanic agent, an antipsychotic, an anxiolytic, a hypnotic, a sympathomimetic, a stimulant, donepezil, tacrine, an asthma medication, a beta agonist, an inhaled steroid, a leukotriene inhibitor, a methylxanthine, a cromolyn, an epinephrine or analog, dornase alpha (Pulmozyme), a cytokine or a cytokine antagonist. Non-limiting examples of such cytokines include, but are not limted to, any of IL-1 to IL-23. Suitable dosages are well known in the art. See, e.g., Wells et al., eds., Pharmacotherapy Handbook, 2nd Edition, Appleton and Lange, Stamford, CT (2000); PDR Pharmacopoeia, Tarascon Pocket Pharmacopoeia 2000, Deluxe Edition, Tarascon Publishing, Loma Linda, CA (2000), each of which references are entirely incorporated herein by reference.

Such compositions can also include toxin molecules that are associated, bound, co-formulated or co-administered with at least one antibody or polypeptide of the present invention. The toxin can optionally act to selectively kill the pathologic cell or tissue. The pathologic cell can be a cancer or other cell. Such toxins can be, but are not limited to, purified or recombinant toxin or toxin fragment comprising at least one functional cytotoxic domain of toxin, e.g., selected from at least one of ricin, diphtheria toxin, a venom toxin, or a bacterial toxin. The term toxin also includes both endotoxins and exotoxins produced by any naturally occurring, mutant or recombinant bacteria or viruses which may cause any pathological condition in humans and other mammals, including toxin shock, which can result in death. Such toxins may include, but are not limited to, enterotoxigenic *E. coli* heat-labile

enterotoxin (LT), heat-stable enterotoxin (ST), *Shigella* cytotoxin, *Aeromonas* enterotoxins, toxic shock syndrome toxin-1 (TSST-1), Staphylococcal enterotoxin A (SEA), B (SEB), or C (SEC), Streptococcal enterotoxins and the like. Such bacteria include, but are not limited to, strains of a species of enterotoxigenic *E. coli* (ETEC), enterohemorrhagic *E. coli* (e.g., strains of serotype 0157:H7), Staphylococcus species (e.g., *Staphylococcus aureus, Staphylococcus pyogenes*), *Shigella* species (e.g., *Shigella dysenteriae, Shigella flexneri, Shigella boydii, and Shigella sonnei*), *Salmonella* species (e.g., *Salmonella typhi, Salmonella cholera-suis, Salmonella enteritidis*), *Clostridium* species (e.g., *Clostridium perfringens, Clostridium dificile, Clostridium botulinum*), *Camphlobacter* species (e.g., *Camphlobacter jejuni, Camphlobacter fetus*), *Heliobacter* species, (e.g., *Heliobacter pylori*), *Aeromonas* species (e.g., *Aeromonas sobria, Aeromonas hydrophila, Aeromonas caviae*), *Pleisomonas shigelloides, Yersina enterocolitica, Vibrios* species (e.g., *Vibrios cholerae, Vibrios parahemolyticus*), *Klebsiella* species, *Pseudomonas aeruginosa*, and *Streptococci*. See, e.g., Stein, ed., INTERNAL MEDICINE, 3rd ed., pp 1-13, Little, Brown and Co., Boston, (1990); Evans et al., eds., Bacterial Infections of Humans: Epidemiology and Control, 2d. Ed., pp 239-254, Plenum Medical Book Co., New York (1991); Mandell et al, Principles and Practice of Infectious Diseases, 3d. Ed., Churchill Livingstone, New York (1990); Berkow et al, eds., *The Merck Manual*, 16th edition, Merck and Co., Rahway, N.J., 1992; Wood et al, FEMS Microbiology Immunology, 76:121-134 (1991); Marrack et al, Science, 248:705-711 (1990), the contents of which references are incorporated entirely herein by reference.

CH1-deleted mimetibody or specified portion or variant compositions of the present invention can further comprise at least one of any suitable auxiliary, such as, but not limited to, diluent, binder, stabilizer, buffers, salts, lipophilic solvents, preservative, adjuvant or the like. Pharmaceutically acceptable auxiliaries are preferred. Non-limiting examples of, and methods of preparing such sterile solutions are well known in the art, such as, but limited to, Gennaro, Ed., *Remington's Pharmaceutical Sciences*, 18th Edition, Mack Publishing Co. (Easton, PA) 1990. Pharmaceutically acceptable carriers can be routinely selected that are suitable for the mode of administration, solubility and/or stability of the CH1-deleted mimetibody composition as well known in the art or as described herein.

Pharmaceutical excipients and additives useful in the present composition include but are not limited to proteins, peptides, amino acids, lipids, and carbohydrates (e.g., sugars, including monosaccharides, di-, tri-, tetra-, and oligosaccharides; derivatized sugars such as alditols, aldonic acids, esterified sugars and the like; and polysaccharides or sugar polymers), which can be present singly or in combination, comprising alone or in combination 1-99.99% by weight or volume. Exemplary protein excipients include serum albumin such as human serum albumin (HSA), recombinant human albumin (rHA), gelatin, casein, and the like. Representative amino acid/CH1-deleted mimetibody or specified portion or variant components, which can also function in a buffering

capacity, include alanine, glycine, arginine, betaine, histidine, glutamic acid, aspartic acid, cysteine, lysine, leucine, isoleucine, valine, methionine, phenylalanine, aspartame, and the like. One preferred amino acid is glycine.

Carbohydrate excipients suitable for use in the invention include, for example, monosaccharides such as fructose, maltose, galactose, glucose, D-mannose, sorbose, and the like; disaccharides, such as lactose, sucrose, trehalose, cellobiose, and the like; polysaccharides, such as raffinose, melezitose, maltodextrins, dextrans, starches, and the like; and alditols, such as mannitol, xylitol, maltitol, lactitol, xylitol sorbitol (glucitol), myoinositol and the like. Preferred carbohydrate excipients for use in the present invention are mannitol, trehalose, and raffinose.

CH1-deleted mimetibody compositions can also include a buffer or a pH adjusting agent; typically, the buffer is a salt prepared from an organic acid or base. Representative buffers include organic acid salts such as salts of citric acid, ascorbic acid, gluconic acid, carbonic acid, tartaric acid, succinic acid, acetic acid, or phthalic acid; Tris, tromethamine hydrochloride, or phosphate buffers. Preferred buffers for use in the present compositions are organic acid salts such as citrate.

Additionally, the CH1-deleted mimetibody or specified portion or variant compositions of the invention can include polymeric excipients/additives such as polyvinylpyrrolidones, ficolls (a polymeric sugar), dextrates (e.g., cyclodextrins, such as 2-hydroxypropyl-β-cyclodextrin), polyethylene glycols, flavoring agents, antimicrobial agents, sweeteners, antioxidants, antistatic agents, surfactants (e.g., polysorbates such as "TWEEN 20" and "TWEEN 80"), lipids (*e.g.*, phospholipids, fatty acids), steroids (e.g., cholesterol), and chelating agents (e.g., EDTA).

These and additional known pharmaceutical excipients and/or additives suitable for use in the CH1-deleted mimetibody compositions according to the invention are known in the art, e.g., as listed in "Remington: The Science & Practice of Pharmacy", 19th ed., Williams & Williams, (1995), and in the "Physician's Desk Reference", 52nd ed., Medical Economics, Montvale, NJ (1998), the disclosures of which are entirely incorporated herein by reference. Preferrred carrier or excipient materials are carbohydrates (e.g., saccharides and alditols) and buffers (e.g., citrate) or polymeric agents.

Formulations

As noted above, the invention provides for stable formulations, which can preferably include a suitable buffer with saline or a chosen salt, as well as optional preserved solutions and formulations containing a preservative as well as multi-use preserved formulations suitable for pharmaceutical or veterinary use, comprising at least one CH1-deleted mimetibody or specified portion or variant in a pharmaceutically acceptable formulation. Preserved formulations contain at least one known preservative or optionally selected from the group consisting of at least one phenol, m-cresol, p-cresol, o-cresol, chlorocresol, benzyl alcohol, phenylmercuric nitrite, phenoxyethanol, formaldehyde, chlorobutanol, magnesium chloride (e.g., hexahydrate), alkylparaben (methyl, ethyl, propyl, butyl and

the like), benzalkonium chloride, benzethonium chloride, sodium dehydroacetate and thimerosal, or mixtures thereof in an aqueous diluent. Any suitable concentration or mixture can be used as known in the art, such as 0.001-5%, or any range or value therein, such as, but not limited to 0.001, 0.003, 0.005, 0.009, 0.01, 0.02, 0.03, 0.05, 0.09, 0.1, 0.2, 0.3, 0.4., 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.3, 4.5, 4.6, 4.7, 4.8, 4.9, or any range or value therein. Non-limiting examples include, no preservative, 0.1-2% m-cresol (e.g., 0.2, 0.3. 0.4, 0.5, 0.9, 1.0%), 0.1-3% benzyl alcohol (e.g., 0.5, 0.9, 1.1., 1.5, 1.9, 2.0, 2.5%), 0.001-0.5% thimerosal (e.g., 0.005, 0.01), 0.001-2.0% phenol (e.g., 0.05, 0.25, 0.28, 0.5, 0.9, 1.0%), 0.0005-1.0% alkylparaben(s) (e.g., 0.00075, 0.0009, 0.001, 0.002, 0.005, 0.0075, 0.009, 0.01, 0.02, 0.05, 0.075, 0.09, 0.1, 0.2, 0.3, 0.5, 0.75, 0.9, 1.0%), and the like.

As noted above, the invention provides an article of manufacture, comprising packaging material and at least one vial comprising a solution of at least one CH1-deleted mimetibody or specified portion or variant with the prescribed buffers and/or preservatives, optionally in an aqueous diluent, wherein said packaging material comprises a label that indicates that such solution can be held over a period of 1, 2, 3, 4, 5, 6, 9, 12, 18, 20, 24, 30, 36, 40, 48, 54, 60, 66, 72 hours or greater. The invention further comprises an article of manufacture, comprising packaging material, a first vial comprising lyophilized at least one CH1-deleted mimetibody or specified portion or variant, and a second vial comprising an aqueous diluent of prescribed buffer or preservative, wherein said packaging material comprises a label that instructs a patient to reconstitute the at least one CH1-deleted mimetibody or specified portion or variant in the aqueous diluent to form a solution that can be held over a period of twenty-four hours or greater.

The at least one CH1-deleted mimetibody or specified portion or variant used in accordance with the present invention can be produced by recombinant means, including from mammalian cell or transgenic preparations, or can be purified from other biological sources, as described herein or as known in the art.

The range of amounts of at least one CH1-deleted mimetibody or specified portion or variant in the product of the present invention includes amounts yielding upon reconstitution, if in a wet/dry system, concentrations from about 1.0 μg/ml to about 1000 mg/ml, although lower and higher concentrations are operable and are dependent on the intended delivery vehicle, e.g., solution formulations will differ from transdermal patch, pulmonary, transmucosal, or osmotic or micro pump methods.

Preferably, the aqueous diluent optionally further comprises a pharmaceutically acceptable preservative. Preferred preservatives include those selected from the group consisting of phenol, m-cresol, p-cresol, o-cresol, chlorocresol, benzyl alcohol, alkylparaben (methyl, ethyl, propyl, butyl and the like), benzalkonium chloride, benzethonium chloride, sodium dehydroacetate and thimerosal, or

mixtures thereof. The concentration of preservative used in the formulation is a concentration sufficient to yield an anti-microbial effect. Such concentrations are dependent on the preservative selected and are readily determined by the skilled artisan.

Other excipients, e.g. isotonicity agents, buffers, antioxidants, preservative enhancers, can be optionally and preferably added to the diluent. An isotonicity agent, such as glycerin, is commonly used at known concentrations. A physiologically tolerated buffer is preferably added to provide improved pH control. The formulations can cover a wide range of pHs, such as from about pH 4 to about pH 10, and preferred ranges from about pH 5 to about pH 9, and a most preferred range of about 6.0 to about 8.0. Preferably the formulations of the present invention have pH between about 6.8 and about 7.8. Preferred buffers include phosphate buffers, most preferably sodium phosphate, particularly phosphate buffered saline (PBS).

Other additives, such as a pharmaceutically acceptable solubilizers like Tween 20 (polyoxyethylene (20) sorbitan monolaurate), Tween 40 (polyoxyethylene (20) sorbitan monopalmitate), Tween 80 (polyoxyethylene (20) sorbitan monooleate), Pluronic F68 (polyoxyethylene polyoxypropylene block copolymers), and PEG (polyethylene glycol) or non-ionic surfactants such as polysorbate 20 or 80 or poloxamer 184 or 188, Pluronic® polyls, other block co-polymers, and chelators such as EDTA and EGTA can optionally be added to the formulations or compositions to reduce aggregation. These additives are particularly useful if a pump or plastic container is used to administer the formulation. The presence of pharmaceutically acceptable surfactant mitigates the propensity for the protein to aggregate.

The formulations of the present invention can be prepared by a process which comprises mixing at least one CH1-deleted mimetibody or specified portion or variant and a preservative selected from the group consisting of phenol, m-cresol, p-cresol, o-cresol, chlorocresol, benzyl alcohol, alkylparaben, (methyl, ethyl, propyl, butyl and the like), benzalkonium chloride, benzethonium chloride, sodium dehydroacetate and thimerosal or mixtures thereof in an aqueous diluent. Mixing the at least one CH1-deleted mimetibody or specified portion or variant and preservative in an aqueous diluent is carried out using conventional dissolution and mixing procedures. To prepare a suitable formulation, for example, a measured amount of at least one CH1-deleted mimetibody or specified portion or variant in buffered solution is combined with the desired preservative in a buffered solution in quantities sufficient to provide the protein and preservative at the desired concentrations. Variations of this process would be recognized by one of ordinary skill in the art. For example, the order the components are added, whether additional additives are used, the temperature and pH at which the formulation is prepared, are all factors that may be optimized for the concentration and means of administration used.

The claimed formulations can be provided to patients as clear solutions or as dual vials

comprising a vial of lyophilized at least one CH1-deleted mimetibody or specified portion or variant that is reconstituted with a second vial containing water, a preservative and/or excipients, preferably a phosphate buffer and/or saline and a chosen salt, in an aqueous diluent. Either a single solution vial or dual vial requiring reconstitution can be reused multiple times and can suffice for a single or multiple cycles of patient treatment and thus can provide a more convenient treatment regimen than currently available.

The present claimed articles of manufacture are useful for administration over a period of immediately to twenty-four hours or greater. Accordingly, the presently claimed articles of manufacture offer significant advantages to the patient. Formulations of the invention can optionally be safely stored at temperatures of from about 2 to about 40°C and retain the biologically activity of the protein for extended periods of time, thus, allowing a package label indicating that the solution can be held and/or used over a period of 6, 12, 18, 24, 36, 48, 72, or 96 hours or greater. If preserved diluent is used, such label can include use up to at least one of 1-12 months, one-half, one and a half, and/or two years.

The solutions of at least one CH1-deleted mimetibody or specified portion or variant in the invention can be prepared by a process that comprises mixing at least one CH1-deleted mimetibody or specified portion or variant in an aqueous diluent. Mixing is carried out using conventional dissolution and mixing procedures. To prepare a suitable diluent, for example, a measured amount of at least one CH1-deleted mimetibody or specified portion or variant in water or buffer is combined in quantities sufficient to provide the protein and optionally a preservative or buffer at the desired concentrations. Variations of this process would be recognized by one of ordinary skill in the art. For example, the order the components are added, whether additional additives are used, the temperature and pH at which the formulation is prepared, are all factors that may be optimized for the concentration and means of administration used.

The claimed products can be provided to patients as clear solutions or as dual vials comprising a vial of lyophilized at least one CH1-deleted mimetibody or specified portion or variant that is reconstituted with a second vial containing the aqueous diluent. Either a single solution vial or dual vial requiring reconstitution can be reused multiple times and can suffice for a single or multiple cycles of patient treatment and thus provides a more convenient treatment regimen than currently available.

The claimed products can be provided indirectly to patients by providing to pharmacies, clinics, or other such institutions and facilities, clear solutions or dual vials comprising a vial of lyophilized at least one CH1-deleted mimetibody or specified portion or variant that is reconstituted with a second vial containing the aqueous diluent. The clear solution in this case can be up to one liter or even larger in size, providing a large reservoir from which smaller portions of the at

least one CH1-deleted mimetibody or specified portion or variant solution can be retrieved one or multiple times for transfer into smaller vials and provided by the pharmacy or clinic to their customers and/or patients.

Recognized devices comprising these single vial systems include those pen-injector devices for delivery of a solution such as Humaject®, NovoPen®, B-D®Pen, AutoPen®, and OptiPen®. Recognized devices comprising a dual vial system include those pen-injector systems for reconstituting a lyophilized drug in a cartridge for delivery of the reconstituted solution such as the HumatroPen®.

The products presently claimed include packaging material. The packaging material provides, in addition to the information required by the regulatory agencies, the conditions under which the product can be used. The packaging material of the present invention provides instructions to the patient to reconstitute the at least one CH1-deleted mimetibody or specified portion or variant in the aqueous diluent to form a solution and to use the solution over a period of 2-24 hours or greater for the two vial, wet/dry, product. For the single vial, solution product, the label indicates that such solution can be used over a period of 2-24 hours or greater. The presently claimed products are useful for human pharmaceutical product use.

The formulations of the present invention can be prepared by a process that comprises mixing at least one CH1-deleted mimetibody or specified portion or variant and a selected buffer, preferably a phosphate buffer containing saline or a chosen salt. Mixing the at least one CH1-deleted mimetibody or specified portion or variant and buffer in an aqueous diluent is carried out using conventional dissolution and mixing procedures. To prepare a suitable formulation, for example, a measured amount of at least one CH1-deleted mimetibody or specified portion or variant in water or buffer is combined with the desired buffering agent in water in quantities sufficient to provide the protein and buffer at the desired concentrations. Variations of this process would be recognized by one of ordinary skill in the art. For example, the order the components are added, whether additional additives are used, the temperature and pH at which the formulation is prepared, are all factors that can be optimized for the concentration and means of administration used.

The claimed stable or preserved formulations can be provided to patients as clear solutions or as dual vials comprising a vial of lyophilized at least one CH1-deleted mimetibody or specified portion or variant that is reconstituted with a second vial containing a preservative or buffer and excipients in an aqueous diluent. Either a single solution vial or dual vial requiring reconstitution can be reused multiple times and can suffice for a single or multiple cycles of patient treatment and thus provides a more convenient treatment regimen than currently available.

At least one CH1-deleted mimetibody or specified portion or variant in either the stable or preserved formulations or solutions described herein, can be administered to a patient in accordance with the present invention via a variety of delivery methods including SC or IM injection; transdermal,

pulmonary, transmucosal, implant, osmotic pump, cartridge, micro pump, or other means appreciated by the skilled artisan, as well-known in the art.

Therapeutic Applications

The present invention for mimetibodies also provides a method for modulating or treating anemia, in a cell, tissue, organ, animal, or patient including, but not limited to, at least one of any anemia, cancer treatment related anemia, radiotherapy or chemotherapy related anemia, viral or bacterial infection treatment related anemia, renal anemia, anemia of prematurity, pediatric and/or adult cancer-associated anemia, anemia associated with lymphoma, myeloma, multple myeloma, AIDS-associated anemia, concomitant treatment for patients with or without autologous blood donation awaiting elective surgery, preoperatve and post operative for surgery, autologous blood donation or transfusion, perioperative management, cyclic neutropenia or Kostmann syndrome (congenital agranulocytosis), end-stage renal disease, anemia associated with dialysis, chronic renal insufficiency, primary hemopoietic diseases, such as congenital hypoplastic anemia, thalassemia major, or sickle cell disease, vaso-occlusive complications of sickle cell disease. Furman et al., Pediatrics 1992; 90: 716-728, Goldberg Science. 1988;242:1412-1415; Paul et al., Exp Hematol. 1984;12:825-830; Erslev et al., Arch Intern Med. 1968;122:230-235; Ersley et al., Ann Clin Lab Sci. 1980;10:250-257; Jacobs et al., Nature. 1985;313:806-810; Lin et al., Proc Natl Acad Sci USA. 1985;82:7580-7584; Law et al., Proc Natl Acad Sci USA. 1986;83:6920-6924; Goldwasser et al., J Biol Chem. 1974;249:4202-4206; Eaves et a., Blood. 1978;52:1196-1210; Sawyer et al., Blood. 1989;74:103-109; Winearls et al., Lancet. 1986;2:1175-1178; Eschbach et al., N Engl J Med. 1987;316:73-78; Eschbach et al., Ann Intern Med. 1989;111:992-1000, each reference entirely incoporated herein by reference.

Mimetibodies of the present invention can also be used for non-renal forms of anemia induced, for example, by chronic infections, inflammatory processes, radiation therapy, and cytostatic drug treatment, and encouraging results in patients with non-renal anemia have been reported. See, e.g., Abels RI and Rudnick SA Erythropoietin: evolving clinical applications. Experimental Hematology 19: 842-50 (1991); Graber SE and Krantz SB Erythropoietin: biology and clinical use. Hematology/Oncol. Clin. North Amer. 3: 369-400 (1989); Jelkman W and Gross AJ (eds) Erythropoietin. Springer, Berlin 1989; Koury MJ and Bondurant MC The molecular mechanism of erythropoietin action. European Journal of Biochemistry 210: 649-63 (1992); Krantz SB Erythropoietin. Blood 77: 419-34 (1991); Tabbara IA Erythropoietin. Biology and clinical applications. Archives of Internal Medicine 153: 298-304 (1993), each entirely incorporated herein by reference.

The present invention also provides a method for modulating or treating an anemia or blood cell related condition, in a cell, tissue, organ, animal, or patient, wherein said anemia or blood cell related condition is associated with at least one including, but not limited to, at least one of immune

related disease, cardiovascular disease, infectious, malignant and/or neurologic disease. Such a method can optionally comprise administering an effective amount of at least one composition or pharmaceutical composition comprising at least one CH1-deleted mimetibody or specified portion or variant to a cell, tissue, organ, animal or patient in need of such modulation, treatment or therapy.

The present invention also provides a method for modulating or treating cancer/infecteous disease in a cell, tissue, organ, animal or patient, including, but not limited to, at least one of acute or chronic bacterial infection, acute and chronic parasitic or infectious processes, including bacterial, viral and fungal infections, HIV infection/HIV neuropathy, meningitis, hepatitis, septic arthritis, peritonitis, pneumonia , epiglottitis, e. coli 0157:h7, hemolytic uremic syndrome/thrombolytic thrombocytopenic purpura, malaria, dengue hemorrhagic fever, leishmaniasis, leprosy, toxic shock syndrome, streptococcal myositis, gas gangrene, mycobacterium tuberculosis, mycobacterium avium intracellulare, pneumocystis carinii pneumonia, pelvic inflammatory disease, orchitis/epidydimitis, legionella, lyme disease, influenza a, epstein-barr virus, vital-associated hemaphagocytic syndrome, vital encephalitis/aseptic meningitis, and the like; (ii) leukemia, acute leukemia, acute lymphoblastic leukemia (ALL), B-cell, T-cell or FAB ALL, acute myeloid leukemia (AML), chromic myelocytic leukemia (CML), chronic lymphocytic leukemia (CLL), hairy cell leukemia, myelodyplastic syndrome (MDS), a lymphoma, Hodgkin's disease, a malignamt lymphoma, non-hodgkin's lymphoma, Burkitt's lymphoma, multiple myeloma, Kaposi's sarcoma, colorectal carcinoma, pancreatic carcinoma, nasopharyngeal carcinoma, malignant histiocytosis, paraneoplastic syndrome/hypercalcemia of malignancy, solid tumors, adenocarcinomas, sarcomas, malignant melanoma, and the like; or (iii) neurodegenerative diseases, multiple sclerosis, migraine headache, AIDS dementia complex, demyelinating diseases, such as multiple sclerosis and acute transverse myelitis; extrapyramidal and cerebellar disorders' such as lesions of the corticospinal system; disorders of the basal ganglia or cerebellar disorders; hyperkinetic movement disorders such as Huntington's Chorea and senile chorea; drug-induced movement disorders, such as those induced by drugs which block CNS dopamine receptors; hypokinetic movement disorders, such as Parkinson's disease; Progressive supranucleo Palsy; structural lesions of the cerebellum; spinocerebellar degenerations, such as spinal ataxia, Friedreich's ataxia, cerebellar cortical degenerations, multiple systems degenerations (Mencel, Dejerine-Thomas, Shi-Drager, and Machado-Joseph); systemic disorders (Refsum's disease, abetalipoprotemia, ataxia, telangiectasia, and mitochondrial multi.system disorder); demyelinating core disorders, such as multiple sclerosis, acute transverse myelitis; and disorders of the motor unit' such as neurogenic muscular atrophies (anterior horn cell degeneration, such as amyotrophic lateral sclerosis, infantile spinal muscular atrophy and juvenile spinal muscular atrophy); Alzheimer's disease; Down's Syndrome in middle age; Diffuse Lewy body disease; Senile Dementia of Lewy body type; Wernicke-Korsakoff syndrome; chronic alcoholism; Creutzfeldt-Jakob disease; Subacute sclerosing

panencephalitis, Hallerrorden-Spatz disease; and Dementia pugilistica, and the like. Such a method can optionally comprise administering an effective amount of a composition or pharmaceutical composition comprising at least one TNF antibody or specified portion or variant to a cell, tissue, organ, animal or patient in need of such modulation, treatment or therapy. See, e.g., the Merck Manual, 16th Edition, Merck & Company, Rahway, NJ (1992)

Such a method can optionally comprise administering an effective amount of at least one composition or pharmaceutical composition comprising at least one CH1-deleted mimetibody or specified portion or variant to a cell, tissue, organ, animal or patient in need of such modulation, treatment or therapy.

The present invention also provides a method for modulating or treating at least one cardiovascular disease in a cell, tissue, organ, animal, or patient, including, but not limited to, at least one of cardiac stun syndrome, myocardial infarction, congestive heart failure, stroke, ischemic stroke, hemorrhage, arteriosclerosis, atherosclerosis, diabetic ateriosclerotic disease, hypertension, arterial hypertension, renovascular hypertension, syncope, shock, syphilis of the cardiovascular system, heart failure, cor pulmonale, primary pulmonary hypertension, cardiac arrhythmias, atrial ectopic beats, atrial flutter, atrial fibrillation (sustained or paroxysmal), chaotic or multifocal atrial tachycardia, regular narrow QRS tachycardia, specific arrythmias, ventricular fibrillation, His bundle arrythmias, atrioventricular block, bundle branch block, myocardial ischemic disorders, coronary artery disease, angina pectoris, myocardial infarction, cardiomyopathy, dilated congestive cardiomyopathy, restrictive cardiomyopathy, valvular heart diseases, endocarditis, pericardial disease, cardiac tumors, aordic and peripheral aneuryisms, aortic dissection, inflammation of the aorta, occulsion of the abdominal aorta and its branches, peripheral vascular disorders, occulsive arterial disorders, peripheral atherlosclerotic disease, thromboangitis obliterans, functional peripheral arterial disorders, Raynaud's phenomenon and disease, acrocyanosis, erythromelalgia, venous diseases, venous thrombosis, varicose veins, arteriovenous fistula, lymphederma, lipedema, unstable angina, reperfusion injury, post pump syndrome, ischemia-reperfusion injury, and the like. Such a method can optionally comprise administering an effective amount of a composition or pharmaceutical composition comprising at least one CH1-deleted mimetibody or specified portion or variant to a cell, tissue, organ, animal or patient in need of such modulation, treatment or therapy.

Any method of the present invention can comprise administering an effective amount of a composition or pharmaceutical composition comprising at least one CH1-deleted mimetibody or specified portion or variant to a cell, tissue, organ, animal or patient in need of such modulation, treatment or therapy. Such a method can optionally further comprise co-administration or combination therapy for treating such immune diseases, wherein the administering of said at least one CH1-deleted mimetibody, specified portion or variant thereof, further comprises administering, before concurrently,

and/or after, at least one selected from at least one TNF antagonist (e.g., but not limited to a TNF antibody or fragment, a soluble TNF receptor or fragment, fusion proteins thereof, or a small molecule TNF antagonist), an antirheumatic, a muscle relaxant, a narcotic, a non-steroid anti-inflammatory drug (NSAID), an analgesic, an anesthetic, a sedative, a local anethetic, a neuromuscular blocker, an antimicrobial (e.g., aminoglycoside, an antifungal, an antiparasitic, an antiviral, a carbapenem, cephalosporin, a flurorquinolone, a macrolide, a penicillin, a sulfonamide, a tetracycline, another antimicrobial), an antipsoriatic, a corticosteriod, an anabolic steroid, a diabetes related agent, a mineral, a nutritional, a thyroid agent, a vitamin, a calcium related hormone, an antidiarrheal, an antitussive, an antiemetic, an antiulcer, a laxative, an anticoagulant, an erythropieitin (e.g., epoetin alpha), a filgrastim (e.g., G-CSF, Neupogen), a sargramostim (GM-CSF, Leukine), an immunization, an immunoglobulin, an immunosuppressive (e.g., basiliximab, cyclosporine, daclizumab), a growth hormone, a hormone replacement drug, an estrogen receptor modulator, a mydriatic, a cycloplegic, an alkylating agent, an antimetabolite, a mitotic inhibitor, a radiopharmaceutical, an antidepressant, antimanic agent, an antipsychotic, an anxiolytic, a hypnotic, a sympathomimetic, a stimulant, donepezil, tacrine, an asthma medication, a beta agonist, an inhaled steroid, a leukotriene inhibitor, a methylxanthine, a cromolyn, an epinephrine or analog, dornase alpha (Pulmozyme), a cytokine or a cytokine antagonist. Suitable dosages are well known in the art. See, e.g., Wells et al., eds., Pharmacotherapy Handbook, 2nd Edition, Appleton and Lange, Stamford, CT (2000); PDR Pharmacopoeia, Tarascon Pocket Pharmacopoeia 2000, Deluxe Edition, Tarascon Publishing, Loma Linda, CA (2000), each of which references are entirely incorporated herein by reference.

Mimetibodies can also be used ex vivo, such as in autologous marrow culture. Briefly, bone marrow is removed from a patient prior to chemotherapy and treated with TPO and/or EPO, optionally in combination with mimetibodies, optionally in combination with one or more additional cytokines. The treated marrow is then returned to the patient after chemotherapy to speed the recovery of the marrow. In addition, TPO, alone and in combination with EPO mimetibodies and/or EPO, can also be used for the ex vivo expansion of marrow or peripheral blood progenitor (PBPC) cells. Prior to chemotherapy treatment, marrow can be stimulated with stem cell factor (SCF) or G-CSF to release early progenitor cells into peripheral circulation. These progenitors are optionally collected and concentrated from peripheral blood and then treated in culture with TPO and mimetibodies, optionally in combination with one or more other cytokines, including but not limited to SCF, G-CSF, IL-3, GM-CSF, IL-6 or IL-11, to differentiate and proliferate into high-density megakaryocyte cultures, which are optionally then be returned to the patient following high-dose chemotherapy. Doses of TPO for ex vivo treatment of bone marrow will be in the range of 100 pg/ml to 10 ng/ml, preferably 500 pg/ml to 3 ng/ml. Doses of mimetibodies will be equivalent in activity to EPO which can be used from 0.1 units/ml to 20 units/ml, preferably from 0.5 units/ml to 2 units/ml, or any range or value therein.

TNF antagonists suitable for compositions, combination therapy, co-administration, devices and/or methods of the present invention (further comprising at least one anti body, specified portion and variant thereof, of the present invention), include, but are not limited to, anti-TNF antibodies, ligand-binding fragments thereof, and receptor molecules which bind specifically to TNF; compounds which prevent and/or inhibit TNF synthesis, TNF release or its action on target cells, such as thalidomide, tenidap, phosphodiesterase inhibitors (e.g, pentoxifylline and rolipram), A2b adenosine receptor agonists and A2b adenosine receptor enhancers; compounds which prevent and/or inhibit TNF receptor signalling, such as mitogen activated protein (MAP) kinase inhibitors; compounds which block and/or inhibit membrane TNF cleavage, such as metalloproteinase inhibitors; compounds which block and/or inhibit TNF activity, such as angiotensin converting enzyme (ACE) inhibitors (e.g., captopril); and compounds which block and/or inhibit TNF production and/or synthesis, such as MAP kinase inhibitors.

As used herein, a "tumor necrosis factor antibody," "TNF antibody," "TNFα antibody," or fragment and the like decreases, blocks, inhibits, abrogates or interferes with TNFα activity *in vitro, in situ* and/or preferably in *vivo*. For example, a suitable TNF human antibody of the present invention can bind TNFα and includes anti-TNF antibodies, antigen-binding fragments thereof, and specified mutants or domains thereof that bind specifically to TNFα. A suitable TNF antibody or fragment can also decrease block, abrogate, interfere, prevent and/or inhibit TNF RNA, DNA or protein synthesis, TNF release, TNF receptor signaling, membrane TNF cleavage, TNF activity, TNF production and/or synthesis.

Chimeric antibody cA2 consists of the antigen binding variable region of the high-affinity neutralizing mouse anti-human TNFα IgG1 antibody, designated A2, and the constant regions of a human IgG1, kappa immunoglobulin. The human IgG1 Fc region improves allogeneic antibody effector function, increases the circulating serum half-life and decreases the immunogenicity of the antibody. The avidity and epitope specificity of the chimeric antibody cA2 is derived from the variable region of the murine antibody A2. In a particular embodiment, a preferred source for nucleic acids encoding the variable region of the murine antibody A2 is the A2 hybridoma cell line.

Chimeric A2 (cA2) neutralizes the cytotoxic effect of both natural and recombinant human TNFα in a dose dependent manner. From binding assays of chimeric antibody cA2 and recombinant human TNFα, the affinity constant of chimeric antibody cA2 was calculated to be $1.04 \times 10^{10} M^{-1}$. Preferred methods for determining monoclonal antibody specificity and affinity by competitive inhibition can be found in Harlow, *et al.*, *Antibodies: A Laboratory Manual,* Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York, 1988; Colligan *et al.*, eds., *Current Protocols in Immunology,* Greene Publishing Assoc. and Wiley Interscience, New York, (1992-2002); Kozbor *et al.*, *Immunol. Today, 4*:72-79 (1983); Ausubel *et al.*, eds. *Current Protocols in Molecular Biology,* Wiley

Interscience, New York (1987-2002); and Muller, *Meth. Enzymol., 92*:589-601 (1983), which references are entirely incorporated herein by reference.

In a particular embodiment, murine monoclonal antibody A2 is produced by a cell line designated c134A. Chimeric antibody cA2 is produced by a cell line designated c168A.

Additional examples of monoclonal anti-TNF antibodies that can be used in the present invention are described in the art (see, e.g., U.S. Patent No. 5,231,024; Möller, A. *et al., Cytokine 2*(3):162-169 (1990); U.S. Application No. 07/943,852 (filed September 11, 1992); Rathjen *et al.*, International Publication No. WO 91/02078 (published February 21, 1991); Rubin *et al.*, EPO Patent Publication No. 0 218 868 (published April 22, 1987); Yone *et al.*, EPO Patent Publication No. 0 288 088 (October 26, 1988); Liang, *et al., Biochem. Biophys. Res. Comm. 137*:847-854 (1986); Meager, *et al., Hybridoma 6*:305-311 (1987); Fendly *et al., Hybridoma 6*:359-369 (1987); Bringman, *et al., Hybridoma 6*:489-507 (1987); and Hirai, *et al., J. Immunol. Meth. 96*:57-62 (1987), which references are entirely incorporated herein by reference).

TNF Receptor Molecules

Preferred TNF receptor molecules useful in the present invention are those that bind TNFα with high affinity (see, e.g., Feldmann *et al.*, International Publication No. WO 92/07076 (published April 30, 1992); Schall *et al., Cell 61*:361-370 (1990); and Loetscher *et al., Cell 61*:351-359 (1990), which references are entirely incorporated herein by reference) and optionally possess low immunogenicity. In particular, the 55 kDa (p55 TNF-R) and the 75 kDa (p75 TNF-R) TNF cell surface receptors are useful in the present invention. Truncated forms of these receptors, comprising the extracellular domains (ECD) of the receptors or functional portions thereof (see, e.g., Corcoran *et al., Eur. J. Biochem. 223*:831-840 (1994)), are also useful in the present invention. Truncated forms of the TNF receptors, comprising the ECD, have been detected in urine and serum as 30 kDa and 40 kDa TNFα inhibitory binding proteins (Engelmann, H. *et al., J. Biol. Chem. 265*:1531-1536 (1990)). TNF receptor multimeric molecules and TNF immunoreceptor fusion molecules, and derivatives and fragments or portions thereof, are additional examples of TNF receptor molecules which are useful in the methods and compositions of the present invention. The TNF receptor molecules which can be used in the invention are characterized by their ability to treat patients for extended periods with good to excellent alleviation of symptoms and low toxicity. Low immunogenicity and/or high affinity, as well as other undefined properties, may contribute to the therapeutic results achieved.

TNF receptor multimeric molecules useful in the present invention comprise all or a functional portion of the ECD of two or more TNF receptors linked via one or more polypeptide linkers or other nonpeptide linkers, such as polyethylene glycol (PEG). The multimeric molecules can further comprise a signal peptide of a secreted protein to direct expression of the multimeric molecule. These multimeric molecules and methods for their production have been described in U.S. Application No. 08/437,533

(filed May 9, 1995), the content of which is entirely incorporated herein by reference.

TNF immunoreceptor fusion molecules useful in the methods and compositions of the present invention comprise at least one portion of one or more immunoglobulin molecules and all or a functional portion of one or more TNF receptors. These immunoreceptor fusion molecules can be assembled as monomers, or hetero- or homo-multimers. The immunoreceptor fusion molecules can also be monovalent or multivalent. An example of such a TNF immunoreceptor fusion molecule is TNF receptor/IgG fusion protein. TNF immunoreceptor fusion molecules and methods for their production have been described in the art (Lesslauer *et al.*, *Eur. J. Immunol. 21*:2883-2886 (1991); Ashkenazi *et al.*, *Proc. Natl. Acad. Sci. USA 88*:10535-10539 (1991); Peppel *et al.*, *J. Exp. Med. 174*:1483-1489 (1991); Kolls *et al.*, *Proc. Natl. Acad. Sci. USA 91*:215-219 (1994); Butler *et al.*, *Cytokine 6*(6):616-623 (1994); Baker *et al.*, *Eur. J. Immunol. 24*:2040-2048 (1994); Beutler *et al.*, U.S. Patent No. 5,447,851; and U.S. Application No. 08/442,133 (filed May 16, 1995), each of which references are entirely incorporated herein by reference). Methods for producing immunoreceptor fusion molecules can also be found in Capon *et al.*, U.S. Patent No. 5,116,964; Capon *et al.*, U.S. Patent No. 5,225,538; and Capon *et al.*, *Nature 337*:525-531 (1989), which references are entirely incorporated herein by reference.

A functional equivalent, derivative, fragment or region of TNF receptor molecule refers to the portion of the TNF receptor molecule, or the portion of the TNF receptor molecule sequence which encodes TNF receptor molecule, that is of sufficient size and sequences to functionally resemble TNF receptor molecules that can be used in the present invention (e.g., bind TNFα with high affinity and possess low immunogenicity). A functional equivalent of TNF receptor molecule also includes modified TNF receptor molecules that functionally resemble TNF receptor molecules that can be used in the present invention (e.g., bind TNFα with high affinity and possess low immunogenicity). For example, a functional equivalent of TNF receptor molecule can contain a "SILENT" codon or one or more amino acid substitutions, deletions or additions (e.g., substitution of one acidic amino acid for another acidic amino acid; or substitution of one codon encoding the same or different hydrophobic amino acid for another codon encoding a hydrophobic amino acid). See Ausubel *et al.*, *Current Protocols in Molecular Biology*, Greene Publishing Assoc. and Wiley-Interscience, New York (1987-2002).

Cytokines include, but are not limited to all known cytokines. See, e.g., CopewithCytokines.com. Cytokine antagonists include, but are not limited to, any antibody, fragment or mimetic, any soluble receptor, fragment or mimetic, any small molecule antagonist, or any combination thereof.

Any method of the present invention can comprise a method for treating a protein mediated disorder, comprising administering an effective amount of a composition or pharmaceutical

composition comprising at least one CH1-deleted mimetibody or specified portion or variant to a cell, tissue, organ, animal or patient in need of such modulation, treatment or therapy. Such a method can optionally further comprise co-administration or combination therapy for treating such immune diseases, wherein the administering of said at least one CH1-deleted mimetibody, specified portion or variant thereof, further comprises administering, before concurrently, and/or after, at least one selected from at least one other cytokines such as IL-3,-6 and -11; stem cell factor; G-CSF and GM-CSF. Within regimens of combination therapy, daily doses of other cytokines will in general be: GM-CSF, 5-15 .mu.g/kg; IL-3, 1-5 lg/kg; and G-CSF, 1-25 .mu.g/kg. Combination therapy with GM-CSF, for example, is indicated in patients with low neutrophil levels.

Typically, treatment of pathologic conditions is effected by administering an effective amount or dosage of at least one CH1-deleted mimetibody composition that total, on average, a range from at least about 0.01 to 500 milligrams of at least one CH1-deleted mimetibody or specified portion or variant /kilogram of patient per dose, and preferably from at least about 0.1 to 100 milligrams CH1-deleted mimetibody or specified portion or variant /kilogram of patient per single or multiple administration, depending upon the specific activity of contained in the composition. Alternatively, the effective serum concentration can comprise 0.1-5000 μg/ml serum concentration per single or multiple adminstration. Suitable dosages are known to medical practitioners and will, of course, depend upon the particular disease state, specific activity of the composition being administered, and the particular patient undergoing treatment. In some instances, to achieve the desired therapeutic amount, it can be necessary to provide for repeated administration, *i.e.*, repeated individual administrations of a particular monitored or metered dose, where the individual administrations are repeated until the desired daily dose or effect is achieved.

Preferred doses can optionally include 0.01, 0.02, 0.03, 0.04, 0.05. 0.06, 0.07, 0.08, 009, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, and/or 30 mg/kg/administration, or any range, value or fraction thereof, or to achieve a serum concentration of 0.1, 0.5, 0.9, 1.0, 1.1, 1.2, 1.5, 1.9, 2.0, 2.5, 2.9, 3.0, 3.5, 3.9, 4.0, 4.5, 4.9, 5.0, 5.5, 5.9, 6.0, 6.5, 6.9, 7.0, 7.5, 7.9, 8.0, 8.5, 8.9, 9.0, 9.5, 9.9, 10, 10.5, 10.9, 11, 11.5, 11.9, 20, 12.5, 12.9, 13.0, 13.5, 13.9, 14.0, 14.5, 4.9, 5.0, 5.5., 5.9, 6.0, 6.5, 6.9, 7.0, 7.5, 7.9, 8.0, 8.5, 8.9, 9.0, 9.5, 9.9, 10, 10.5, 10.9, 11, 11.5, 11.9, 12, 12.5, 12.9, 13.0, 13.5, 13.9, 14, 14.5, 15, 15.5, 15.9, 16, 16.5, 16.9, 17, 17.5, 17.9, 18, 18.5, 18.9, 19, 19.5, 19.9, 20, 20.5, 20.9, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 96, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500, and/or 5000 μg/ml serum concentration per single or multiple administration, or any range, value or fraction thereof.

Alternatively, the dosage administered can vary depending upon known factors, such as the pharmacodynamic characteristics of the particular agent, and its mode and route of administration; age, health, and weight of the recipient; nature and extent of symptoms, kind of concurrent treatment,

frequency of treatment, and the effect desired. Usually a dosage of active ingredient can be about 0.1 to 100 milligrams per kilogram of body weight. Ordinarily 0.1 to 50, and preferably 0.1 to 10 milligrams per kilogram per administration or in sustained release form is effective to obtain desired results.

As a non-limiting example, treatment of humans or animals can be provided as a one-time or periodic dosage of at least one CH1-deleted mimetibody or specified portion or variant of the present invention 0.01 to 100 mg/kg, such as 0.5, 0.9, 1.0, 1.1, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 40, 45, 50, 60, 70, 80, 90 or 100 mg/kg, per day, on at least one of day 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, or 40, or alternatively, at least one of week 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20, or any combination thereof, using single, infusion or repeated doses.

Dosage forms (composition) suitable for internal administration generally contain from about 0.0001 milligram to about 500 milligrams of active ingredient per unit or container. In these pharmaceutical compositions the active ingredient will ordinarily be present in an amount of about 0.5-95% by weight based on the total weight of the composition.

For parenteral administration, the CH1-deleted mimetibody or specified portion or variant can be formulated as a solution, suspension, emulsion or lyophilized powder in association, or separately provided, with a pharmaceutically acceptable parenteral vehicle. Examples of such vehicles are water, saline, Ringer's solution, dextrose solution, and 5% human serum albumin. Liposomes and nonaqueous vehicles such as fixed oils may also be used. The vehicle or lyophilized powder may contain additives that maintain isotonicity (e.g., sodium chloride, mannitol) and chemical stability (e.g., buffers and preservatives). The formulation is sterilized by known or suitable techniques.

Suitable pharmaceutical carriers are described in the most recent edition of Remington's Pharmaceutical Sciences, A. Osol, a standard reference text in this field.

Therapeutic Administration

Many known and developed modes of can be used according to the present invention for administering pharmaceutically effective amounts of at least one CH1-deleted mimetibody or specified portion or variant according to the present invention. While pulmonary administration is used in the following description, other modes of administration can be used according to the present invention with suitable results.

A CH1-deleted mimetibody of the present invention can be delivered in a carrier, as a solution, emulsion, colloid, or suspension, or as a powder, using any of a variety of devices and methods suitable for administration by inhalation or other modes described here within or known in the art.

Parenteral Formulations and Administration

Formulations for parenteral administration can contain as common excipients sterile water or saline, polyalkylene glycols such as polyethylene glycol, oils of vegetable origin, hydrogenated naphthalenes and the like. Aqueous or oily suspensions for injection can be prepared by using an appropriate emulsifier or humidifier and a suspending agent, according to known methods. Agents for injection can be a non-toxic, non-orally administrable diluting agent such as aquous solution or a sterile injectable solution or suspension in a solvent. As the usable vehicle or solvent, water, Ringer's solution, isotonic saline, etc. are allowed; as an ordinary solvent, or suspending solvent, sterile involatile oil can be used. For these purposes, any kind of involatile oil and fatty acid can be used, including natural or synthetic or semisynthetic fatty oils or fatty acids; natural or synthetic or semisynthtetic mono- or di- or tri-glycerides. Parental administration is known in the art and includes, but is not limited to, conventional means of injections, a gas pressured needle-less injection device as described in U.S. Pat. No. 5,851,198, and a laser perforator device as described in U.S. Pat. No. 5,839,446 entirely incorporated herein by reference.

Alternative Delivery

The invention further relates to the administration of at least one CH1-deleted mimetibody or specified portion or variant by parenteral, subcutaneous, intramuscular, intravenous, bolus, vaginal, rectal, buccal, sublingual, intranasal, or transdermal means. Protein, CH1-deleted mimetibody or specified portion or variant compositions can be prepared for use for parenteral (subcutaneous, intramuscular or intravenous) administration particularly in the form of liquid solutions or suspensions; for use in vaginal or rectal administration particularly in semisolid forms such as creams and suppositories; for buccal, or sublingual administration particularly in the form of tablets or capsules; or intranasally particularly in the form of powders, nasal drops or aerosols or certain agents; or transdermally particularly in the form of a gel, ointment, lotion, suspension or patch delivery system with chemical enhancers such as dimethyl sulfoxide to either modify the skin structure or to increase the drug concentration in the transdermal patch (Junginger, et al. In "Drug Permeation Enhancement"; Hsieh, D. S., Eds., pp. 59-90 (Marcel Dekker, Inc. New York 1994, entirely incorporated herein by reference), or with oxidizing agents that enable the application of formulations containing proteins and peptides onto the skin (WO 98/53847), or applications of electric fields to create transient transport pathways such as electroporation, or to increase the mobility of charged drugs through the skin such as iontophoresis, or application of ultrasound such as sonophoresis (U.S. Pat. Nos. 4,309,989 and 4,767,402) (the above publications and patents being entirely incorporated herein by reference).

Pulmonary/Nasal Administration

For pulmonary administration, preferably at least one CH1-deleted mimetibody or specified portion or variant composition is delivered in a particle size effective for reaching the lower airways of the lung or sinuses. According to the invention, at least one CH1-deleted mimetibody or specified portion or variant can be delivered by any of a variety of inhalation or nasal devices known in the art for administration of a therapeutic agent by inhalation. These devices capable of depositing aerosolized formulations in the sinus cavity or alveoli of a patient include metered dose inhalers, nebulizers, dry powder generators, sprayers, and the like. Other devices suitable for directing the pulmonary or nasal administration of CH1-deleted mimetibody or specified portion or variants are also known in the art. All such devices can use of formulations suitable for the administration for the dispensing of CH1-deleted mimetibody or specified portion or variant in an aerosol. Such aerosols can be comprised of either solutions (both aqueous and non aqueous) or solid particles. Metered dose inhalers like the Ventolin® metered dose inhaler, typically use a propellent gas and require actuation during inspiration (See, e.g., WO 94/16970, WO 98/35888). Dry powder inhalers like Turbuhaler™ (Astra), Rotahaler® (Glaxo), Diskus® (Glaxo), Spiros™ inhaler (Dura), devices marketed by Inhale Therapeutics, and the Spinhaler® powder inhaler (Fisons), use breath-actuation of a mixed powder (US 4668218 Astra, EP 237507 Astra, WO 97/25086 Glaxo, WO 94/08552 Dura, US 5458135 Inhale, WO 94/06498 Fisons, entirely incorporated herein by reference). Nebulizers like AERx™ Aradigm, the Ultravent® nebulizer (Mallinckrodt), and the Acorn II® nebulizer (Marquest Medical Products) (US 5404871 Aradigm, WO 97/22376), the above references entirely incorporated herein by reference, produce aerosols from solutions, while metered dose inhalers, dry powder inhalers, etc. generate small particle aerosols. These specific examples of commercially available inhalation devices are intended to be a representative of specific devices suitable for the practice of this invention, and are not intended as limiting the scope of the invention. Preferably, a composition comprising at least one CH1-deleted mimetibody or specified portion or variant is delivered by a dry powder inhaler or a sprayer. There are a several desirable features of an inhalation device for administering at least one CH1-deleted mimetibody or specified portion or variant of the present invention. For example, delivery by the inhalation device is advantageously reliable, reproducible, and accurate. The inhalation device can optionally deliver small dry particles, e.g. less than about 10 μm, preferably about 1-5 μm, for good respirability.

Administration of CH1-deleted mimetibody or specified portion or variant Compositions as a Spray

A spray including CH1-deleted mimetibody or specified portion or variant composition protein can be produced by forcing a suspension or solution of at least one CH1-deleted mimetibody or

specified portion or variant through a nozzle under pressure. The nozzle size and configuration, the applied pressure, and the liquid feed rate can be chosen to achieve the desired output and particle size. An electrospray can be produced, for example, by an electric field in connection with a capillary or nozzle feed. Advantageously, particles of at least one CH1-deleted mimetibody or specified portion or variant composition protein delivered by a sprayer have a particle size less than about 10 μm, preferably in the range of about 1 μm to about 5 μm, and most preferably about 2 μm to about 3 μm.

Formulations of at least one CH1-deleted mimetibody or specified portion or variant composition protein suitable for use with a sprayer typically include CH1-deleted mimetibody or specified portion or variant composition protein in an aqueous solution at a concentration of about 1 mg to about 20 mg of at least one CH1-deleted mimetibody or specified portion or variant composition protein per ml of solution. The formulation can include agents such as an excipient, a buffer, an isotonicity agent, a preservative, a surfactant, and, preferably, zinc. The formulation can also include an excipient or agent for stabilization of the CH1-deleted mimetibody or specified portion or variant composition protein, such as a buffer, a reducing agent, a bulk protein, or a carbohydrate. Bulk proteins useful in formulating CH1-deleted mimetibody or specified portion or variant composition proteins include albumin, protamine, or the like. Typical carbohydrates useful in formulating CH1-deleted mimetibody or specified portion or variant composition proteins include sucrose, mannitol, lactose, trehalose, glucose, or the like. The CH1-deleted mimetibody or specified portion or variant composition protein formulation can also include a surfactant, which can reduce or prevent surface-induced aggregation of the CH1-deleted mimetibody or specified portion or variant composition protein caused by atomization of the solution in forming an aerosol. Various conventional surfactants can be employed, such as polyoxyethylene fatty acid esters and alcohols, and polyoxyethylene sorbitol fatty acid esters. Amounts will generally range between 0.001 and 14% by weight of the formulation. Especially preferred surfactants for purposes of this invention are polyoxyethylene sorbitan monooleate, polysorbate 80, polysorbate 20, or the like. Additional agents known in the art for formulation of a protein such as mimetibodies, or specified portions or variants, can also be included in the formulation.

Administration of CH1-deleted mimetibody or specified portion or variant compositions by a Nebulizer

CH1-deleted mimetibody or specified portion or variant composition protein can be administered by a nebulizer, such as jet nebulizer or an ultrasonic nebulizer. Typically, in a jet nebulizer, a compressed air source is used to create a high-velocity air jet through an orifice. As the gas expands beyond the nozzle, a low-pressure region is created, which draws a solution of CH1-deleted mimetibody or specified portion or variant composition protein through a capillary tube

connected to a liquid reservoir. The liquid stream from the capillary tube is sheared into unstable filaments and droplets as it exits the tube, creating the aerosol. A range of configurations, flow rates, and baffle types can be employed to achieve the desired performance characteristics from a given jet nebulizer. In an ultrasonic nebulizer, high-frequency electrical energy is used to create vibrational, mechanical energy, typically employing a piezoelectric transducer. This energy is transmitted to the formulation of CH1-deleted mimetibody or specified portion or variant composition protein either directly or through a coupling fluid, creating an aerosol including the CH1-deleted mimetibody or specified portion or variant composition protein. Advantageously, particles of CH1-deleted mimetibody or specified portion or variant composition protein delivered by a nebulizer have a particle size less than about 10 μm, preferably in the range of about 1 μm to about 5 μm, and most preferably about 2 μm to about 3 μm.

Formulations of at least one CH1-deleted mimetibody or specified portion or variant suitable for use with a nebulizer, either jet or ultrasonic, typically include CH1-deleted mimetibody or specified portion or variant composition protein in an aqueous solution at a concentration of about 1 mg to about 20 mg of at least one CH1-deleted mimetibody or specified portion or variant protein per ml of solution. The formulation can include agents such as an excipient, a buffer, an isotonicity agent, a preservative, a surfactant, and, preferably, zinc. The formulation can also include an excipient or agent for stabilization of the at least one CH1-deleted mimetibody or specified portion or variant composition protein, such as a buffer, a reducing agent, a bulk protein, or a carbohydrate. Bulk proteins useful in formulating at least one CH1-deleted mimetibody or specified portion or variant composition proteins include albumin, protamine, or the like. Typical carbohydrates useful in formulating at least one CH1-deleted mimetibody or specified portion or variant include sucrose, mannitol, lactose, trehalose, glucose, or the like. The at least one CH1-deleted mimetibody or specified portion or variant formulation can also include a surfactant, which can reduce or prevent surface-induced aggregation of the at least one CH1-deleted mimetibody or specified portion or variant caused by atomization of the solution in forming an aerosol. Various conventional surfactants can be employed, such as polyoxyethylene fatty acid esters and alcohols, and polyoxyethylene sorbital fatty acid esters. Amounts will generally range between 0.001 and 4% by weight of the formulation. Especially preferred surfactants for purposes of this invention are polyoxyethylene sorbitan mono-oleate, polysorbate 80, polysorbate 20, or the like. Additional agents known in the art for formulation of a protein such as CH1-deleted mimetibody or specified portion or variant protein can also be included in the formulation.

Administration of CH1-deleted mimetibody or specified portion or variant compositions By A Metered Dose Inhaler

In a metered dose inhaler (MDI), a propellant, at least one CH1-deleted mimetibody or

specified portion or variant, and any excipients or other additives are contained in a canister as a mixture including a liquefied compressed gas. Actuation of the metering valve releases the mixture as an aerosol, preferably containing particles in the size range of less than about 10 μm, preferably about 1 μm to about 5 μm, and most preferably about 2 μm to about 3 μm. The desired aerosol particle size can be obtained by employing a formulation of CH1-deleted mimetibody or specified portion or variant composition protein produced by various methods known to those of skill in the art, including jet-milling, spray drying, critical point condensation, or the like. Preferred metered dose inhalers include those manufactured by 3M or Glaxo and employing a hydrofluorocarbon propellant.

Formulations of at least one CH1-deleted mimetibody or specified portion or variant for use with a metered-dose inhaler device will generally include a finely divided powder containing at least one CH1-deleted mimetibody or specified portion or variant as a suspension in a non-aqueous medium, for example, suspended in a propellant with the aid of a surfactant. The propellant can be any conventional material employed for this purpose, such as chlorofluorocarbon, a hydrochlorofluorocarbon, a hydrofluorocarbon, or a hydrocarbon, including trichlorofluoromethane, dichlorodifluoromethane, dichlorotetrafluoroethanol and 1,1,1,2-tetrafluoroethane, HFA-134a (hydrofluroalkane-134a), HFA-227 (hydrofluroalkane-227), or the like. Preferably the propellant is a hydrofluorocarbon. The surfactant can be chosen to stabilize the at least one CH1-deleted mimetibody or specified portion or variant as a suspension in the propellant, to protect the active agent against chemical degradation, and the like. Suitable surfactants include sorbitan trioleate, soya lecithin, oleic acid, or the like. In some cases solution aerosols are preferred using solvents such as ethanol. Additional agents known in the art for formulation of a protein such as protein can also be included in the formulation.

One of ordinary skill in the art will recognize that the methods of the current invention can be achieved by pulmonary administration of at least one CH1-deleted mimetibody or specified portion or variant compositions via devices not described herein.

Mucosal Formulations and Administration

For absorption through mucosal surfaces, compositions and methods of administering at least one CH1-deleted mimetibody or specified portion or variant include an emulsion comprising a plurality of submicron particles, a mucoadhesive macromolecule, a bioactive peptide, and an aqueous continuous phase, which promotes absorption through mucosal surfaces by achieving mucoadhesion of the emulsion particles (U.S. Pat. Nos. 5,514,670). Mucous surfaces suitable for application of the emulsions of the present invention can include corneal, conjunctival, buccal, sublingual, nasal, vaginal, pulmonary, stomachic, intestinal, and rectal routes of administration. Formulations for vaginal or rectal administration, e.g. suppositories, can contain as excipients, for example, polyalkyleneglycols, vaseline, cocoa butter, and the like. Formulations for intranasal administration can be solid and contain as

excipients, for example, lactose or can be aqueous or oily solutions of nasal drops. For buccal administration excipients include sugars, calcium stearate, magnesium stearate, pregelinatined starch, and the like (U.S. Pat. Nos. 5,849,695).

Oral Formulations and Administration

Formulations for oral rely on the co-administration of adjuvants (e.g., resorcinols and nonionic surfactants such as polyoxyethylene oleyl ether and n-hexadecylpolyethylene ether) to increase artificially the permeability of the intestinal walls, as well as the co-administration of enzymatic inhibitors (e.g., pancreatic trypsin inhibitors, diisopropylfluorophosphate (DFF) and trasylol) to inhibit enzymatic degradation. The active constituent compound of the solid-type dosage form for oral administration can be mixed with at least one additive, including sucrose, lactose, cellulose, mannitol, trehalose, raffinose, maltitol, dextran, starches, agar, arginates, chitins, chitosans, pectins, gum tragacanth, gum arabic, gelatin, collagen, casein, albumin, synthetic or semisynthetic polymer, and glyceride. These dosage forms can also contain other type(s) of additives, e.g., inactive diluting agent, lubricant such as magnesium stearate, paraben, preserving agent such as sorbic acid, ascorbic acid, .alpha.-tocopherol, antioxidant such as cysteine, disintegrator, binder, thickener, buffering agent, sweetening agent, flavoring agent, perfuming agent, etc.

Tablets and pills can be further processed into enteric-coated preparations. The liquid preparations for oral administration include emulsion, syrup, elixir, suspension and solution preparations allowable for medical use. These preparations may contain inactive diluting agents ordinarily used in said field, e.g., water. Liposomes have also been described as drug delivery systems for insulin and heparin (U.S. Pat. No. 4,239,754). More recently, microspheres of artificial polymers of mixed amino acids (proteinoids) have been used to deliver pharmaceuticals (U.S. Pat. No. 4,925,673). Furthermore, carrier compounds described in U.S. Pat. No. 5,879,681 and U.S. Pat. No. 5,5,871,753 are used to deliver biologically active agents orally are known in the art.

Transdermal Formulations and Administration

For transdermal administration, the at least one CH1-deleted mimetibody or specified portion or variant is encapsulated in a delivery device such as a liposome or polymeric nanoparticles, microparticle, microcapsule, or microspheres (referred to collectively as microparticles unless otherwise stated). A number of suitable devices are known, including microparticles made of synthetic polymers such as polyhydroxy acids such as polylactic acid, polyglycolic acid and copolymers thereof, polyorthoesters, polyanhydrides, and polyphosphazenes, and natural polymers such as collagen, polyamino acids, albumin and other proteins, alginate and other polysaccharides, and combinations thereof (U.S. Pat. Nos. 5,814,599).

Prolonged Administration and Formulations

It can be sometimes desirable to deliver the compounds of the present invention to the subject

over prolonged periods of time, for example, for periods of one week to one year from a single administration. Various slow release, depot or implant dosage forms can be utilized. For example, a dosage form can contain a pharmaceutically acceptable non-toxic salt of the compounds that has a low degree of solubility in body fluids, for example, (a) an acid addition salt with a polybasic acid such as phosphoric acid, sulfuric acid, citric acid, tartaric acid, tannic acid, pamoic acid, alginic acid, polyglutamic acid, naphthalene mono- or di-sulfonic acids, polygalacturonic acid, and the like; (b) a salt with a polyvalent metal cation such as zinc, calcium, bismuth, barium, magnesium, aluminum, copper, cobalt, nickel, cadmium and the like, or with an organic cation formed from e.g., N,N'-dibenzyl-ethylenediamine or ethylenediamine; or (c) combinations of (a) and (b) e.g. a zinc tannate salt. Additionally, the compounds of the present invention or, preferably, a relatively insoluble salt such as those just described, can be formulated in a gel, for example, an aluminum monostearate gel with, e.g. sesame oil, suitable for injection. Particularly preferred salts are zinc salts, zinc tannate salts, pamoate salts, and the like. Another type of slow release depot formulation for injection would contain the compound or salt dispersed for encapsulated in a slow degrading, non-toxic, non-antigenic polymer such as a polylactic acid/polyglycolic acid polymer for example as described in U.S. Pat. No. 3,773,919. The compounds or, preferably, relatively insoluble salts such as those described above can also be formulated in cholesterol matrix silastic pellets, particularly for use in animals. Additional slow release, depot or implant formulations, e.g. gas or liquid liposomes are known in the literature (U.S. Pat. Nos. 5,770,222 and "Sustained and Controlled Release Drug Delivery Systems", J. R. Robinson ed., Marcel Dekker, Inc., N.Y., 1978).

Having generally described the invention, the same will be more readily understood by reference to the following examples, which are provided by way of illustration and are not intended as limiting.

Example 1: Cloning and Expression of EPO CH1-deleted mimetibody in Mammalian Cells

A typical mammalian expression vector contains at least one promoter element, which mediates the initiation of transcription of mRNA, the CH1-deleted mimetibody or specified portion or variant coding sequence, and signals required for the termination of transcription and polyadenylation of the transcript. Additional elements include enhancers, Kozak sequences and intervening sequences flanked by donor and acceptor sites for RNA splicing. Highly efficient transcription can be achieved with the early and late promoters from SV40, the long terminal repeats (LTRS) from Retroviruses, e.g., RSV, HTLVI, HIVI and the early promoter of the cytomegalovirus (CMV). However, cellular elements can also be used (e.g., the human actin promoter). Suitable expression vectors for use in practicing the present invention include, for example, vectors such as pIRES1neo, pRetro-Off, pRetro-On, PLXSN, or pLNCX (Clonetech Labs, Palo Alto, CA), pcDNA3.1 (+/-), pcDNA/Zeo (+/-) or pcDNA3.1/Hygro (+/-) (Invitrogen), PSVL and PMSG (Pharmacia, Uppsala, Sweden), pRSVcat (ATCC 37152), pSV2dhfr (ATCC 37146) and pBC12MI (ATCC 67109). Mammalian host cells that could be used include human Hela 293, H9 and Jurkat cells, mouse NIH3T3 and C127 cells, Cos 1, Cos 7 and CV 1, quail QC1-3 cells, mouse L cells and Chinese hamster ovary (CHO) cells.

Alternatively, the gene can be expressed in stable cell lines that contain the gene integrated into a chromosome. The co-transfection with a selectable marker such as dhfr, gpt, neomycin, or hygromycin allows the identification and isolation of the transfected cells.

The transfected gene can also be amplified to express large amounts of the encoded CH1-deleted mimetibody or specified portion or variant. The DHFR (dihydrofolate reductase) marker is useful to develop cell lines that carry several hundred or even several thousand copies of the gene of interest. Another useful selection marker is the enzyme glutamine synthase (GS) (Murphy, et al., Biochem. J. 227:277-279 (1991); Bebbington, et al., Bio/Technology 10:169-175 (1992)). Using these markers, the mammalian cells are grown in selective medium and the cells with the highest resistance are selected. These cell lines contain the amplified gene(s) integrated into a chromosome. Chinese hamster ovary (CHO) and NSO cells are often used for the production of CH1-deleted mimetibody or specified portion or variants.

The expression vectors pC1 and pC4 contain the strong promoter (LTR) of the Rous Sarcoma Virus (Cullen, et al., Molec. Cell. Biol. 5:438-447 (1985)) plus a fragment of the CMV-enhancer (Boshart, et al., Cell 41:521-530 (1985)). Multiple cloning sites, e.g., with the restriction enzyme cleavage sites BamHI, XbaI and Asp718, facilitate the cloning of the gene of interest. The vectors contain in addition the 3' intron, the polyadenylation and termination signal of the rat preproinsulin gene.

Cloning and Expression in CHO Cells

The vector pC4 is used for the expression of CH1-deleted mimetibody or specified portion or variant. Plasmid pC4 is a derivative of the plasmid pSV2-dhfr (ATCC Accession No. 37146). The plasmid contains the mouse DHFR gene under control of the SV40 early promoter. Chinese hamster ovary- or other cells lacking dihydrofolate activity that are transfected with these plasmids can be selected by growing the cells in a selective medium (e.g., alpha minus MEM, Life Technologies, Gaithersburg, MD) supplemented with the chemotherapeutic agent methotrexate. The amplification of the DHFR genes in cells resistant to methotrexate (MTX) has been well documented (see, e.g., F. W. Alt, et al., J. Biol. Chem. 253:1357-1370 (1978); J. L. Hamlin and C. Ma, Biochem. et Biophys. Acta 1097:107-143 (1990); and M. J. Page and M. A. Sydenham, Biotechnology 9:64-68 (1991)). Cells grown in increasing concentrations of MTX develop resistance to the drug by overproducing the target enzyme, DHFR, as a result of amplification of the DHFR gene. If a second gene is linked to the DHFR gene, it is usually co-amplified and over-expressed. It is known in the art that this approach can be used to develop cell lines carrying more than 1,000 copies of the amplified gene(s). Subsequently, when the methotrexate is withdrawn, cell lines are obtained that contain the amplified gene integrated into one or more chromosome(s) of the host cell.

Plasmid pC4 contains for expressing the gene of interest the strong promoter of the long terminal repeat (LTR) of the Rous Sarcoma Virus (Cullen, et al., Molec. Cell. Biol. 5:438-447 (1985)) plus a fragment isolated from the enhancer of the immediate early gene of human cytomegalovirus (CMV) (Boshart, et al., Cell 41:521-530 (1985)). Downstream of the promoter are BamHI, XbaI, and Asp718 restriction enzyme cleavage sites that allow integration of the genes. Behind these cloning sites the plasmid contains the 3' intron and polyadenylation site of the rat preproinsulin gene. Other high efficiency promoters can also be used for the expression, e.g., the human b-actin promoter, the SV40 early or late promoters or the long terminal repeats from other retroviruses, e.g., HIV and HTLVI. Clontech's Tet-Off and Tet-On gene expression systems and similar systems can be used to express the EPO in a regulated way in mammalian cells (M. Gossen, and H. Bujard, Proc. Natl. Acad. Sci. USA 89: 5547-5551 (1992)). For the polyadenylation of the mRNA other signals, e.g., from the human growth hormone or globin genes can be used as well. Stable cell lines carrying a gene of interest integrated into the chromosomes can also be selected upon co-transfection with a selectable marker such as gpt, G418 or hygromycin. It is advantageous to use more than one selectable marker in the beginning, e.g., G418 plus methotrexate.

The plasmid pC4 is digested with restriction enzymes and then dephosphorylated using calf intestinal phosphatase by procedures known in the art. The vector is then isolated from a 1% agarose gel.

The DNA sequence encoding the complete CH1-deleted mimetibody or specified portion or variant is used, e.g., as presented in SEQID NOS: 13, 14, 15, 16, 17, 18, corresponding to HC and LC variable regions of a CH1-deleted mimetibody of the present invention, according to known method steps. Isolated nucleic acid encoding a suitable human constant region (i.e., HC and LC regions) is also used in this construct (e.g., as provided in vector p1351.

The isolated variable and constant region encoding DNA and the dephosphorylated vector are then ligated with T4 DNA ligase. E. coli HB101 or XL-1 Blue cells are then transformed and bacteria are identified that contain the fragment inserted into plasmid pC4 using, for instance, restriction enzyme analysis.

Chinese hamster ovary (CHO) cells lacking an active DHFR gene are used for transfection. 5 μg of the expression plasmid pC4 is cotransfected with 0.5 μg of the plasmid pSV2-neo using lipofectin. The plasmid pSV2neo contains a dominant selectable marker, the neo gene from Tn5 encoding an enzyme that confers resistance to a group of antibiotics including G418. The cells are seeded in alpha minus MEM supplemented with 1 μg /ml G418. After 2 days, the cells are trypsinized and seeded in hybridoma cloning plates (Greiner, Germany) in alpha minus MEM supplemented with 10, 25, or 50 ng/ml of methotrexate plus 1 μg /ml G418. After about 10-14 days single clones are trypsinized and then seeded in 6-well petri dishes or 10 ml flasks using different concentrations of methotrexate (50 nM, 100 nM, 200 nM, 400 nM, 800 nM). Clones growing at the highest concentrations of methotrexate are then transferred to new 6-well plates containing even higher concentrations of methotrexate (1 mM, 2 mM, 5 mM, 10 mM, 20 mM). The same procedure is repeated until clones are obtained that grow at a concentration of 100 - 200 mM. Expression of the desired gene product is analyzed, for instance, by SDS-PAGE and Western blot or by reverse phase HPLC analysis.

Example 2: Non-Limiting Example of an CH1 deleted Mimetibody of the Invention

Background: EMP-1 (EPO mimetic peptide-1) is a 20 amino acid peptide with no sequence homology to human erythropoietin (HuEPO), but with the ability (as a dimer) to activate the EPO receptor (Wrighton et al, 1996, Science, vol. **273**, 458-463). However, its relatively low activity (10,000 to 100,000 fold less than HuEPO) and short half-life *(ex-vivo* half-life of 8 hours in 50% serum, *in vivo* half-life unknown), compromise its utility as a therapeutic. Therefore, a way was needed to confer upon the peptide a longer half-life, without disturbing, and possibly improving its potency. To this end, several attempts have been made to increase the activity of EMP-1 by stabilizing the dimerization of the peptide or by incorporating the peptide into larger structures to increase half-life. Wrighten et al. (1997, Nature Biotechnology, vol. **15**, 1261-65) combined biotin labeled EMP-1 with streptavidin to stabilize dimerization. They saw a 100 fold increase in activity in an *in vitro* cell proliferation assay. They also used anti-biotin antibodies to stabilize the peptide dimer, however only a 10-fold increase in activity was

seen. The same authors prepared a chemically defined dimeric form of EMP-1. In this case an 100-fold increase in activity was seen *in vivo*. Another group sought to improve the activity of EMP-1 through covalent linkage to polyethylene glycol (PEG) (Johnson et al., 1997, Chem. & Bio., vol. 4(12), 939-50). They reported an increase in potency of up to 1000 fold, however the construct was found to be immunogenic in mice (the antibodies were directed to the peptide) (Dana Johnson, Personal communications). Kuai et al. (2000, J. Peptide Res., vol. **56**, 59-62) inserted the EMP-1 peptide into the sequence of plasminogen activator inhibitor-1, (PAI-1). It was thought that the insertion of EMP-1 into this scaffold would both stabilize dimerization and increase half-life. In an *in vivo* assay the potency of this construct was seen to be 2500 fold higher than EMP-1 alone. It should be noted that different *in vitro* assays and *in vivo* models were used in these studies and the reported potencies may not be comparable to each other or to results presented herein.

EMP-1 CH1 Deleted Mimetibody of the Present Invention

A specific, non-limiting, example of this invention is the EMP-NfusCG1 construct where V is the first three amino acids of a naturally occurring antibody, Pep is a single copy of the bioactive EMP-1 peptide and Flex is a tandem repeat of the Gly-Gly-Gly-Ser flexible linker. V2 is the J region of a naturally occurring IgG, pHinge is the complete IgG1 hinge region and CH2 & CH3 are of the IgG1 isotype subclass. It is thought that this structure will constrain the EMP-1 peptide, but allow sufficient flexibility such that the dimerization of the peptides as part of the assembled homodimer is stabilized. In support of this, the activity of EMP-NfusCG1 in an *in vitro* cell proliferation assay is approximately 550 fold more than the EMP-1 peptide and only 4 to 6 fold less than recombinant HuEPO (rHuEPO). In addition, it is expected that the half-life of this construct will be many times that of rHuEPO or the EMP-1 peptide alone and similar to that of an IgG. Consistently, normal mice treated with EMP-NfusCG1 attain a significantly higher maximal hematocrit compared to mice treated with rHuEPO, when equal activity units are given, and elevated levels are maintained for a longer period. This construct is efficiently secreted from cells and appears to be properly folded; overcoming problems associated with 1st generation mimetibodies.

In addition to the basic structure described above, variants with potentially favorable biological characteristics are described. These include constructs that may have a decreased tendency to self-associate, reduced immune effector functions or decreased immunogenicity. Other modifications that confer desired characteristics such as improved conformation of the biologically active peptide, and transfer across the blood-brain barrier are envisioned. The proposed variants and modifications may be combined in any fashion to yield constructs with desired activities.

Using recombinant DNA methods, the EMP-1 peptide was inserted into an intermediate vector between an immunoglobulin signal peptide and a human J sequence. This was done using

complementary synthetic oligonucletides with ends compatible with the Bst1107I and KpnI restriction sites present in the vector

($^{5'}$TACAGGCCCAGATCCAGGGCGGTACCTACAGCTGCCACTTCGGGCCCCTC

ACGTGGGTGTGCAAGCCCCAGGGCGGCGGAAGCGGGGGAGGCTCCGGTAC$^{3'}$ and

$^{3'}$CGGAGCCTCCC

CCGCTTCCGCCGCCCTGGGGCTTGCACACCCACGTGAGGGGCCCGAAGTGGCAGCTGT

AGGTACCGCCCTGGATCTGGGCCTGTA$^{5'}$) (SEQ ID NO:1111). These oligonucleotides contained coding sequence for the signal peptidase consensus site, the EMP-1 peptide, and a flexible linker composed of two Gly-Gly-Gly-Ser repeats. An XbaI restriction fragment containing the above-mentioned functional elements was then transferred into an expression vector. This vector contained the anti-CD4 immunoglobulin promoter and enhancer, and the coding sequence for the human IgG1 hinge, HC constant region 2 (CH2) and constant region 3 (CH3) as well as the necessary elements for plasmid replication and selection in bacteria and selection for stable expressers in mammalian cells.

This plasmid was linearized and introduced into the NSO mouse myeloma cell line via electroporation. Resistant cells were selected and high expressers of EMP-NfusCG1 were identified by ELISA assay of culture supernatants. Purification of the construct from cell culture supernatants was accomplished by standard proteinA affinity chromatography. Passage of the purified product through SDS-containing polyacrylamide gels under both denaturing and reducing conditions confirmed the expected size of the purified product. The identity of the purified protein was further confirmed by mass spectrometry and N-terminal sequencing.

The amino acid sequence of EMP-NfusCG1 is shown below (Figure 1). Functional domains are annotated above the peptide coding sequence. The three amino acid signal peptide consensus sequence corresponds to the first three amino acids of a naturally occurring immunoglobulin. These amino acids are thought to contribute to the efficient removal of the signal peptide by signal peptidase in the endoplasmic reticulum. This sequence is immediately followed by the EMP-1 coding sequence. The two C-terminal amino acids of the EMP-1 sequence combined with the next six amino acids form a flexible linker characterized by the Gly-Gly-Gly-Ser repeat. A human joining (J) region sequence follows. It is thought that the J sequence will provide even more flexibility to allow the EMP-1 dimmer to assume the proper conformation, and allow the dimmer to protrude from the globular structure of the immunoglobulin and penetrate into the cleft between two EPO receptors. The HC hinge region is also included in the construct immediately following the J region. There are three cysteines in the IgG1 hinge region (highlighted). The first would normally pair to the immunoglobulin light chain (LC) and the second two participate in interchain bonds between two HCs. The remainder of the

sequence is composed of the CH2 & CH3 regions, which constitute the bulk of the protein. One of the reasons that immunoglobulins are believed to have a long serum half-life is their ability to bind the FcRn that extends the serum half-life by returning pinocytosed immunoglobulin back to the extracellular space. The binding site of the FcRn overlaps the junction of the CH2 and CH3 regions (Sheilds et al, 2001, J. Biol. Chem., vol. 276 (9), 6591-6604).

```
        Signal Peptidase
       Consensus Sequence                    J Region
            ---                      Linker--------
                 EMP-1 Peptide       ------              huG1 Hinge
              ~~~~~~~~~~~~~~~~~~~~        ~~~~~~~~~~~~~~~~~~~~~~~~
       1  QIQGGTYSCHFGPLTWVCKPQGGGSGGGSGTLVTVSSEPKSCDKTHTCPPCPAPELLGGP
                                        IgG1 CH2
          ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
      61  SVFLFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPREEQYNS

                              IgG1 CH2
          ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~      IgG1 CH3

                                                       ~~~~~~~~~~~~~~~~~~
     121  TYRVVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAKGQPREPQVYTLPPSRDEL
                                        IgG1 CH3
          ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
     181  TKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQ
                    IgG1 CH3
          ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
     241  QGNVFSCSVMHEALHNHYTQKSLSLSPGK                  (SEQ ID NO:1112)
```

Figure 1. The peptide sequence of EMP-NfusCG1 showing important functional domains.

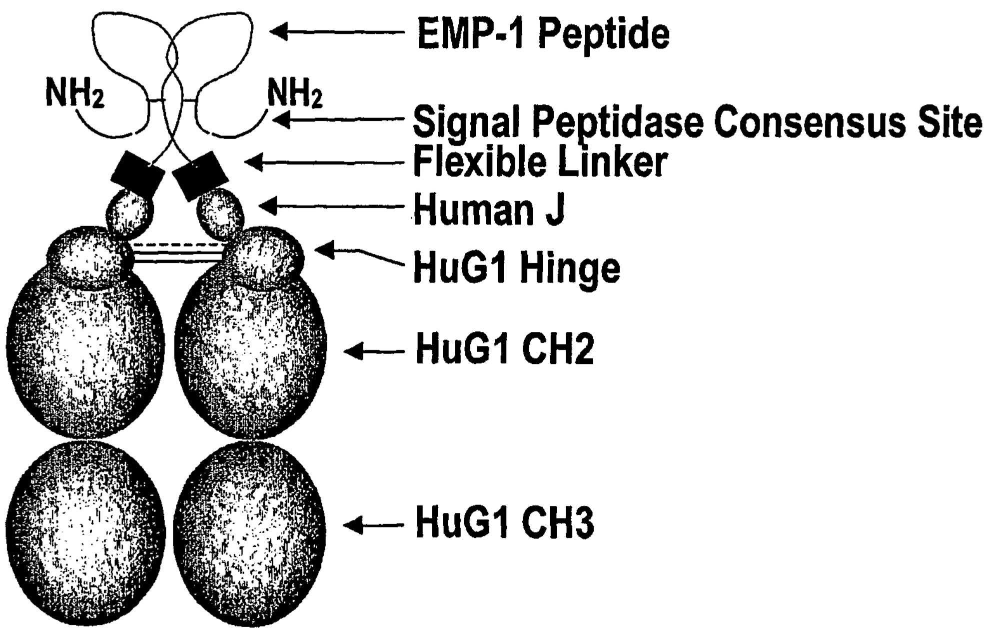

Figure 2. A graphical depiction of the expected structure of the assembled EMP-NfusCG1 construct.

It is well known that two IgG heavy chains are assembled during cellular processing via disulfide bonds between cysteines located in the hinge region to form a homodimer. It is expected that this will also occur between the modified peptides to form the assembled EMP-NfusCG1 construct. In addition, it is expected that the intrachain disulfide bond between the two cysteines in the EMP-1 peptide

will also form. The expected structure of EMP-NfusCG1 is shown in Figure 2. As shown, each assembled EMP-NfusCG1 contains two EMP-1 peptides. The spatial arrangement of the peptides at the N-terminus along with the flexibility of adjoining sequences should allow the peptides to form the bioacive dimer. Also shown, as solid black lines, are the interchain disulfide bonds between the HCs. The dashed red line shows a third interchain disulfide bond that could potentially form between the two cysteines that normally pair with the LC. However, this cysteine could also remain reduced or could form a disulfide bond with free cysteine.

The activity of EMP-NfusCG1 was first tested in an *in vitro* bioactivity assay. For this assay, the EPO dependent UT-7/EPO cell line, derived from a patient with acute megakaryoblastic leukemia, was used (Komatsu et al., 1993, Blood, vol. **82** (2), 456-464). These cells undergo programmed cell death 48 to 72 hours after withdraw from media supplemented with rHuEPO. Cells that have been incubated in the absence of rHuEPO for 24 hours can be saved if treated with rHuEPO or an EPO agonist. EMP-NfusCG1 was added to cells starved without rHuEPO and cell viability was determined 48 hours after treatment using the tetrazolium compound MTS (CellTiter 96 Aq_{ueous} One Solution, Promega) that is metabolized by living cells to yield a product with an absorbance that can be measured. Results of a typical assay are presented in Figure 3. Generally, the potency of EMP-NfusCG1 on a molar basis is 500 fold greater than the EMP-1 peptide and 5 fold less than rHuEPO. In addition, these same cells were stimulated with EMP-NfusCG1 and tyrosine phosphorylation patterns visualized by running cell lysate through a polyacrylamide gel (Figure 4). The pattern exhibited by EMP-NfusCG1 was similar to that of rHuEPO, indicating that the mechanism by which EMP-NfusCG1 acts on these cells is like that of rHuEPO.

In vivo studies were done in normal mice to compare the half-life of EMP-NfusCG1 to that of rHuEPO and to compare their effects on erythropoiesis. Preliminary studies indicated that the response to rHuEPO was more pronounced when the mice were dosed on two consecutive days, rather than a single dose. Also seen in preliminary studies, when rHuEPO was dosed at 2000 U/kg the hematocrit of the mice was maximally elevated on day 4 and fell back to near baseline levels by day 7. To compare the effect of EMP-NfusCG1 to rHuEPO, the dose of EMP-NfusCG1 was normalized based on activity in the in vitro bioactivity assay; approximately five times more EMP-NfusCG1 was given since it was 5x less active in the assay. The difference in molecular weights was also taken into consideration (rHuEPO = 30,400 daltons, EMP-NfusCG1 = 62,200 daltons). When mice were dosed equally, based on these considerations, EMP-NfusCG1 gave a higher maximal response and the response was prolonged compared to rHuEPO (Figure 5).

The serum concentrations of both rHuEPO and EMP-NfusCG1 were measured by ELISA. In an assay sensitive to concentrations of rHuEPO as low as 2.5 mU/ml no positive signals were seen from day 4 samples at a 1:8 dilution. This is consistent with the expected 2 to 8 hour half-life of rHuEPO in

rodents. (PRI Expert Report, Part IC2: Toxico-Pharmacological Documentation). In contrast, levels of EMP-NfusCG1 as high as 1.5 ug/mL were detected on day 4 and remained high through the end of the study. (Figure 6). The linearity of the clearance profile in Figure 6 is unusual. It may be that, since the first time point was 3 days after the last injection, the maximum concentration (C_{max}) was reached before the first sample was taken and therefore the peak of the exponential curve was not observed. Another explanation is that the absorption and elimination profiles of this novel construct are such that the clearance profile appears linear. Based on this data, an approximate half-life of 10.8 days can be calculated, several times that of rHuEPO.

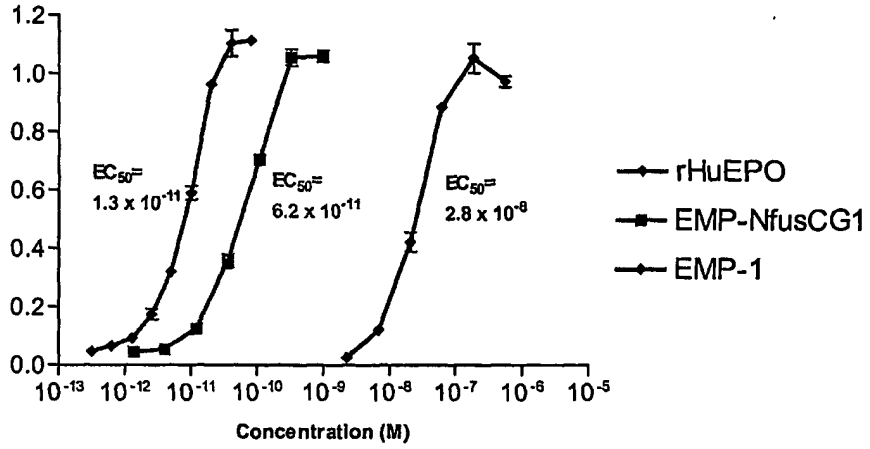

Figure 3. The results of a typical bioactivity assay comparing EMP-NfusCG1 to rHuEPO and EMP-1.

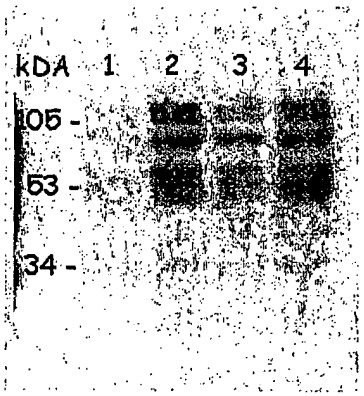

Figure 4. The phosporylation pattern from cells given no treatment (lane 1), cells stimulated with rHuEPO (lane 2), or cells stimulated with EMP-NfusCG1 (lanes 3 & 4).

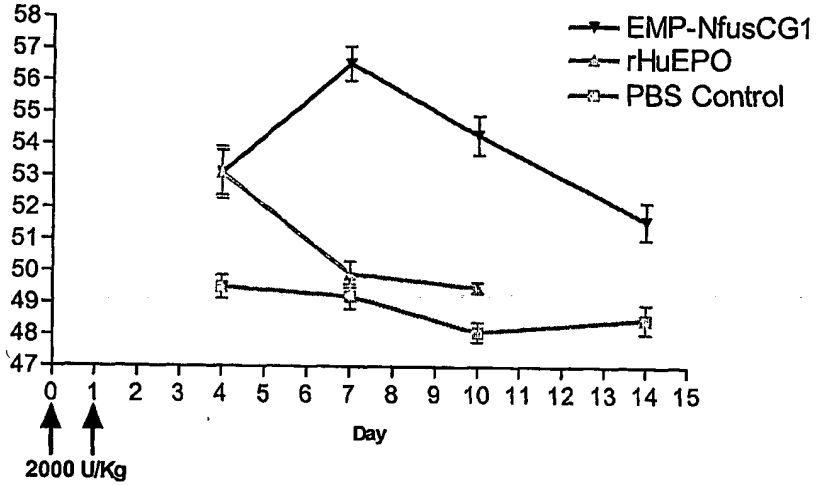

Figure 5. Hematocrits of mice treated with PBS, rHuEPO, or EMP-NfusCG1.

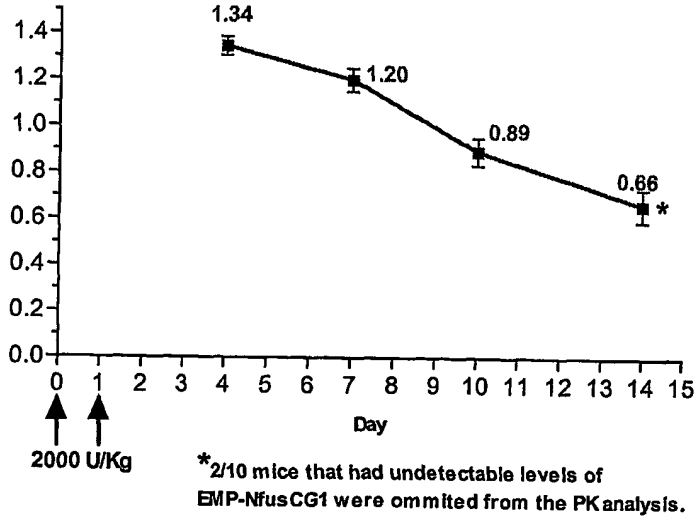

Figure 6. Pharmacokinetics of EMP-NfusCG1 in normal mice.

In addition to EMP-NfusCG1, three similar constructs were made that differ in the isotype of the hinge CH2 and CH3 regions or in the number of elements included to allow flexibility of the EMP-1 peptide. One of the constructs, termed EMP-NfusCG4 is identical to EMP-NfusCG1 except that the hinge and constant regions are of the G4 subtype. Specifically, the XbaI restriction fragment used to construct the EMP-NfusCG1 expression plasmid was transferred into a vector that provided the anti-CD4 immunoglobulin promoter and enhancer, and the coding sequence for the human IgG4 hinge, CH2 and CH3 as well as the necessary elements for plasmid replication and selection in bacteria and selection for

stable expressers in mammalian cells. This plasmid was expressed and purified in a manner similar to that of EMP-NfusCG1. The coding sequence of EMP-NfusCG4 is shown below (Figure 7).

```
                                                        HuG4 Hinge
5                  Sequence identical to EMP-NfusCG1  ~~~~~~~~~~~~~~~~~~~
                   ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~                  ~~~
                 1 QIQGGTYSCHFGPLTWVCKPQGGGSGGGSGGTLVTVSSESKYGPPCPSCPAPEFLGGPSVF
                                        IgG4 CH2
                   ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
10               61 LFPPKPKDTLMISRTPEVTCVVVDVSQEDPEVQFNWYVDGVEVHNAKTKPREEQFNSTYR
                                                                  IgG4 CH3
                              IgG4 CH2                  ~~~~~~~~~~~~~~~~~~~~
                   ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                121 VVSVLTVLHQDWLNGKEYKCKVSNKGLPSSIEKTISKAKGQPREPQVYTLPPSQEEMTKN
15                                      IgG4 CH3
                   ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                181 QVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGSFFLYSRLTVDKSRWQEGN
                          IgG4 CH3
                   ~~~~~~~~~~~~~~~~~~~~~~~~~
20              241 VFSCSVMHEALHNHYTQKSLSLSLGK                        SEQ ID NO:1113
```

Figure 7. The peptide sequence of EPM-NfusCG4 showing functional domains that differ from EMP-NfusCG1.

The following shows a comparison a couple of examples of a CH1 deleted mimetibody:

```
25          QIQGGTYSCHFGPLTWVCKPQGGGSGGGSGTLVTVSSEPKSCDKTH-TCPPCPAPELL
MG1    ---.....................................-.....................
CG4    ........................................S.YGPP-----..S.....F.
MG4    ---.....................................S.YGPP-----..S.....F.

30  muCG2a.....................................RGPTIKPCPPCK....N..
```

An important difference between the IgG1 and IgG4 subtypes is in the number of cysteines in the hinge region. Like the G1 subtype, there are two cysteines in the IgG4 hinge which participate in the disulfide bond between heavy chains. The cysteine which is normally involved in disulfide bonding to the LC is absent from the G4 hinge; it is located in the G4 CH1 region which is absent from this construct. The IgG4 hinge region is less flexible than the IgG1 hinge and this may impact potential conformations of the EMP-NfusCG1 dimer (Dangl et al. 1997, EMBO Journal, vol 7 (7), 1989-94). In addition, the two isotypes differ in their ability to mediate complement dependent cytotoxicity (CDC) and antibody dependant cellular cytotoxicity (ADCC). The G1 subtype is a strong inducer of the complement cascade, while the G4 subtype has little activity (Dangl et al. 1997, EMBO Journal, vol 7 (7), 1989-94). In addition, the G1 subtype binds with high affinity to the Fc receptor and contributes to cell mediated cytotoxicity while the G4 subtype binds weakly (Allan & Seed, 1989, Science, vol. **423**, 378-80). The relative inability of the G4 subtype to activate effector functions is desirable since proliferation of the target cells is desired. The binding site for the FcRn scavenger receptor is present in on the IgG4 and

since there do not appear to be any IgG subclass differences in binding, the pharmacokinetics are expected to be similar to the G1 subtype (West et al, 2000, Biochem., vol 39, 9698-9708).

As with the G1 construct EMP-NfusCG4 is expected to form a homodimer via the two cysteines located in the hinge region. As mentioned above, the absence of a third cysteine in the G4 hinge negates the possibility of a third disulfide bond between the two chains. The conformation of the EMP-1 dimer may also be different because of the differences in size and flexibility of the hinge regions. Noting these differences, the general structure of the EMP-NfusCG4 is expected to be similar to EMP-NfusCG4.

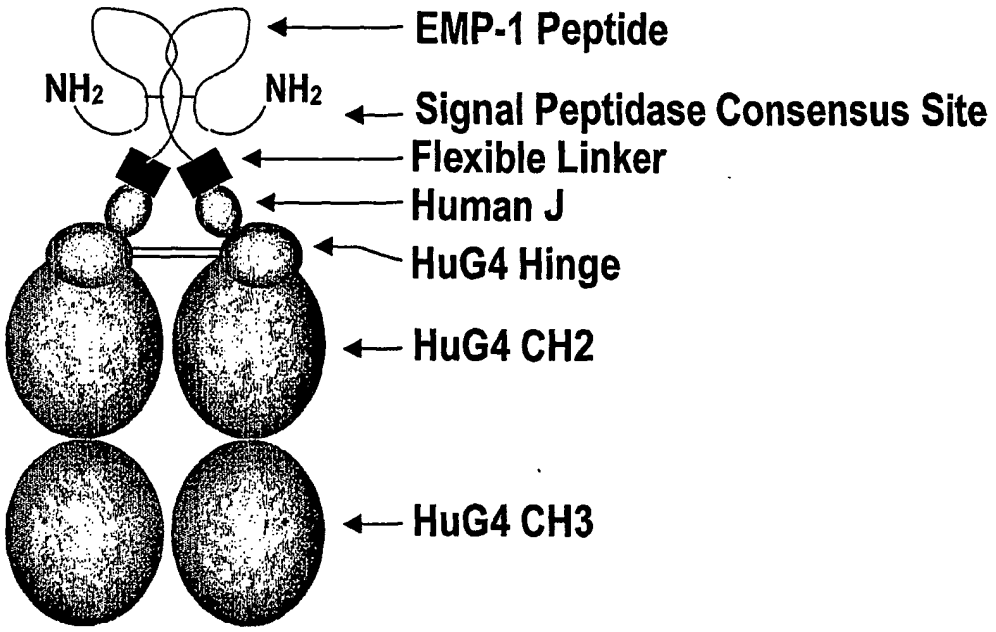

Figure 8. A graphical depiction of the expected structure of the assembled EMP-NfusCG4 construct.

The EMP-NfusCG4 was tested an *in vitro* bioactivity assay as described previously. The assay was done twice with similar results; Figure 9 shows the results of one of the assays. The potency of EMP-NfusCG4 is 13 fold less than EMP-NfusCG1 in this assay, however, on average, the difference is about 10 fold. Since EMP-NfusCG1 is 5 fold less potent than rHuEPO the difference between EMP-NfusCG4 and rHuEPO would be expected to be about 50 fold. In this assay the actual difference is 60 fold. The difference between EMP-NfusCG4 and EMP-1 in this assay is 40 fold, however the EC_{50} value for EMP-1 is 2 fold lower than the historical average, so the actual difference between EMP-NfusCG4 and EMP-1 may be greater. The lower activity observed with EMP-NfusCG4 is attributed to the differences in the hinge that may not allow the EMP-1 dimer to form in an optimal conformation. To date EMP-NfusCG4 has not been tested *in vivo*.

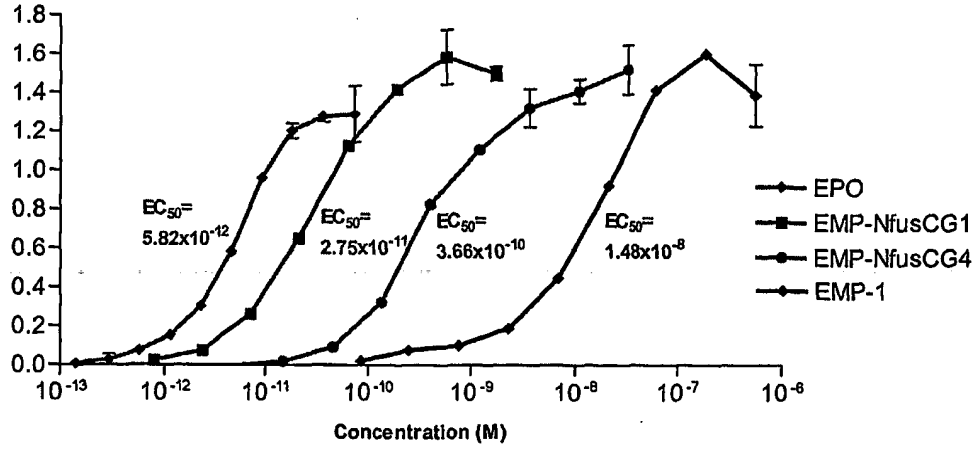

Figure 9. The results of a typical bioactivity assay comparing EMP-NfusCG4 EMP-NfusCG1, rHuEPO and EMP-1.

Two additional constructs were designed to investigate which functional domains are requred for activity. For these, the human J region and one of the Gly-Gly-Gly-Ser repeats were omitted between the EMP-1 sequence and the hinge region. The differences between the previously described "complete" versions and these " mimimal" versions are illustrated in Figure 10. Two minimal versions were constructed that share the same functional domains, but differ in the isotype subclass (G1 vs G4) of the hinge, CH2 and CH3 regions.

```
                Signal Peptidase
                Consensus Sequence                    J Region
                      ~~~                          Linker~~~~~~~~
                           EMP-1 Peptide           ~~~~~~
                       ~~~~~~~~~~~~~~~~~~~~
Complete        QIQGGTYSCHFGPLTWVCKPQGGGSGGGSGTLVTVSS..Hinge   SEQ ID NO:1114

Minimal         QIQGGTYSCHFGPLTWVCKPQGGGS..Hinge               SEQ ID NO:1115
```

Figure 10. Comparison of the N-terminal peptide sequence of the complete and minimal versions.

Construction of expression plasmids for the minimal versions, designated EMP-NfusMG1 and EMP-NfusMG4 was accomplished by inserting synthetic ologonucleotdes into an intermediate vector, as was done to construct the expressions plasmids for EMP-NfusCG1 and EMP-NfusCG4 ($^{5'}$TACAGGCCCAGGGCGGTACCTACAGCTGCCACTTCGGGCCCCTCACGTGGGTGTGCAAG CCCCAGGGCGGCGGATCAGGTAAGTT$^{3'}$ (SEQ ID NO:1116) and $^{3'}$CTAGAACTTACCTGATCCGCCGCCCTGGGGCTTGCACACC CACGTGAGGGGCCCGAAGTGGCAGCTGTAGGTACCGCCCTGGGCCTGTA$^{5'}$) (SEQ ID

NO:1116). These synthetic oligonuceotheds contained coding sequence for the signal peptidase consensus site , the EMP-1 peptide and a single Gly-Gly-Gly-Ser repeat. In this case, however, the 3' end of the oligonucleotides was compatable with the XbaI restriction site unlike the oligonucleotides used to construct the complete versions. By cloning into the XbaI site, which is located downstream of the j region in the intermediate vector, the coding sequence for the J region was omitted. Construction of the final expression plasmids was accomplished as described for EMP-NfusCG1 and EMP-NfusCG4. Because of technical problems, to date, only EMP-NfusMG4 has been expressed and purified. The expected structure of EMP-NfusMG4 is shown in Figure 11. The protursion of the EMP-1 peptide from the globular structure of the protein is expected to be less pronounced than with EMP-NfusCG4, and for this reason the EMP-1 peptide dimer may not be able to penetrate into the cleft between EPO receptors. In addition the flexibility of the EMP-1 peptides to form the optimal dimer conformation may be reduced. This is especially important in light of observations made by Livnah et al. (1998, Nat. Strust. Biol., vol. 5, 993-1004). They discovered a peptide (EMP-33) that could dimerize two EPO receptors, but did not activate the receptor. Comparing the crystal structure of the EMP-33/EPO receptor complex to that of the EMP-1/EPO receptor complex, they found that a slight difference in the orientation of the dimerized receptors was the difference between the peptides ability to activate the receptors. Therefore, if the EMP-1 dimer can not form the optimal conformation it may be unable dimerize the EPO receptor, or may not bring the receptors into an activating conformation.

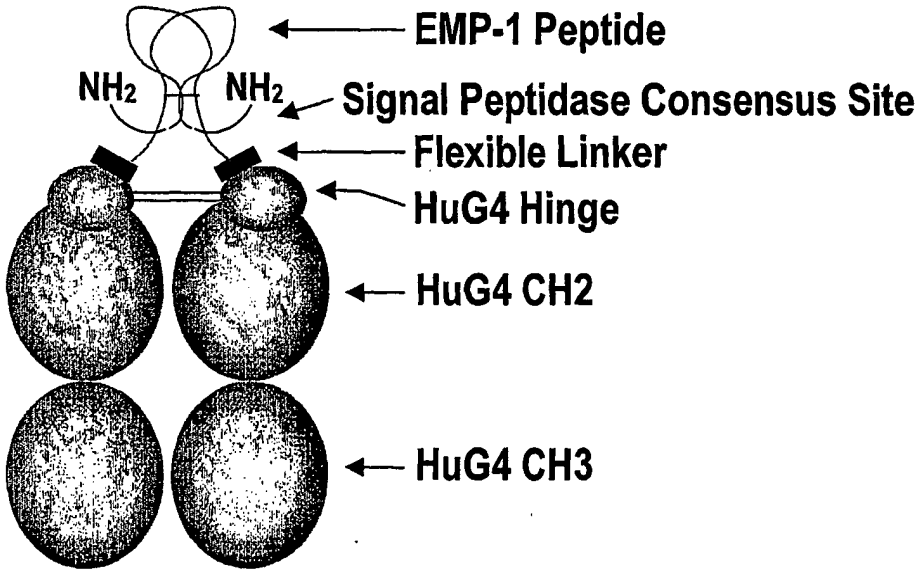

Figure 11. A graphical depiction of the expected structure of the assembled EMP-NfusMG4 construct.

The EMP-NfusMG4 construct was tested for activity in the UT7 *in vitro* bioactivity assay. The results of this assay are presented in Figure 12. Since this assay was done only once, due to the variability of the bioactivity assay these results should be viewed as preliminary. The potency of EMP-NfusMG4 is 227 fold less than rHuEPO and 44 fold more than the EMP-1 peptide in this assay. However, the EC_{50} of rHuEPO in this assay is three fold lower than the historical average, so the difference between EMP-NfusMG4 and rHuEPO may be significantly lower. A direct comparison between EMP-NfusCG4 and EMP-NfusMG4 was not made. Based on a comparison of the average EC_{50} of EMP-NfusCG4, 3.5×10^{-10}, to the EC_{50} of EMP-NfusMG4 observed in this assay, the difference is two fold. While these results are preliminary, this indicates that the absence of the human J sequence and one Gly-Gly-Gly-Ser repeat does not substantially reduce the potency of the EMP-NfusMG4 construct. It is not known if this observation would extend to the EMP-NfusMG1 construct.

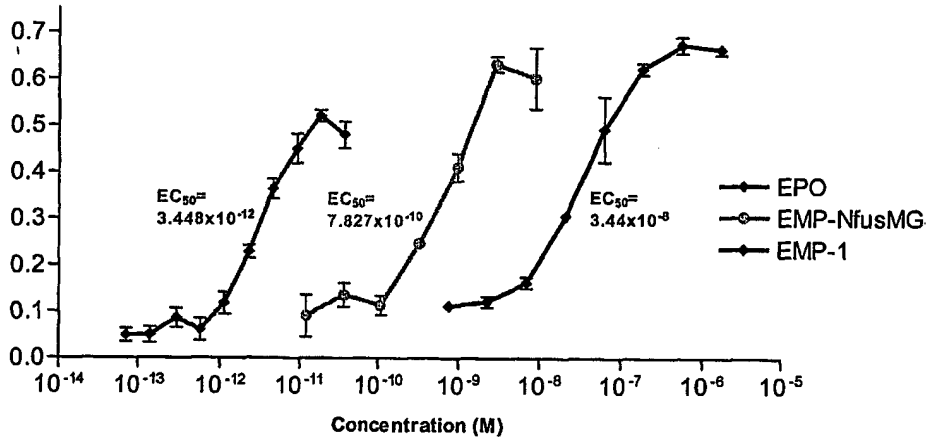

Figure 12. The results of a bioactivity assay comparing EMP-NfusMG4, rHuEPO and EMP-1.

Additional constructs are currently being expressed with single or multiple amino acid changes in order to avoid undesirable activities (Figure 13). These changes may be expressed alone or multiple changes combined in a single construct. The cysteine normally involved in a disulfide bridge between the HC and LC will be mutated to an alanine. While this cysteine may be involved in stabilizing the construct by forming a third disulfide bridge, it is possible that it may aberrantly form a disulfide bond with other cyseines within the construct, or it could form a disulfide linkage between two constructs. By removing the cysteine, proper folding and assembly could be enhanced and the possibility of self-association diminished.

It has been shown that mutation of two lysine (L) residues, L234 & L235, in the IgG1 lower

hinge region to alanine (A) will abrogate the ability of the immunoglobulin to mediate complement dependent cytotoxicity (CDC) and antibody dependant cellular cytotoxicity (ADCC) (Hezereh et al., 2001, J. Virol., vol. 75 (24), 12161-68). Preliminary studies have shown that EMP-NfusCG1 does not mediate complement lysis of cells that express the EPO receptor. This may be due to the low number of receptors that are found on erythroid progenitor cells. In addition the *in vivo* expansion of erythriod progenitors as evidenced by significant increases in hematocrit supports the possible functional irrelevance of immune effector functions. However, while no effector function associated affects have been observed, there remains an interest in introducing these mutations as a precautionary step.

Another modification that would result in a decrease in mediation of immune effector functions is the removal of the glycosylation attachment site. This can be accomplished by mutation of the asparagine at position 297 (N297) to glutamine (Q). Aglycosylated versions of the IgG1 subclass are known to be poor mediators of immune effector function (Jefferis et al. 1998, Immol. Rev., vol. 163, 50-76).

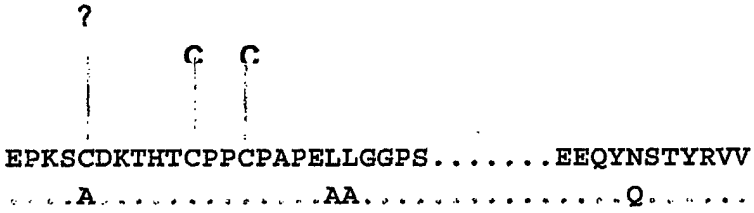

Figure 13. Proposed mutations in the EMP-NfusCG1 hinge and CH2 coding sequences. (SEQ ID NO:1117)

An additional modification that is currently being pursued is the replacement of the IgG1 CH2 and CH3 regions of EMP-NfusCG1 with the same regions of the IgG4 subtype while retaining the G1 hinge region. As discussed previously, the ability of the IgG4 subclass to mediate immune effector functions is much lower than that of the G1 subclass. Also discussed previously, it is theorized that differences between the hinge region flexibility in the two IgG subclasses may be responsible for the differences in activity between EMP-NfusCG1 and EMP-NfusCG4. So this construct might retain the activity of EMP-NfusCG1 without the concerns of potential immune effector functions.

Other envisioned modifications are those that would decrease the potential immunogenicity of the constructs. One important determinant of immunogenicity is the ability of peptides derived from a protein to be efficiently bound and presented by MHC molecules to T cells and to elicit a cell based immune response or T cell help for an antibody response. Using publicly available web based algorithms for MHC binding (SYFPETHI, Ramensee et al., 1999, Immunogenetics, vol. 50, 213-19 and BIMAS) potential MHC binding epitopes within the EMP-1 containing N-terminal region of EMP-NfusCG1 were analyzed (Technical Memo REStm192). The results for MHC class I alleles are

presented in figure 14. Results for the MHC class II alleles are shown in Figure 15. Mutations that would decrease the predicted immunogenicity of one or more peptides may be evaluated for *in vivo* effect on immunogenicity.

(SEQ ID NO:1118):

```
QIQGGTYSCHFGPLTWVCKPQGGGSGGGSGTLVTVSSEPKSCDKTHTCPPC
 IQGGTYSCHF
    GTYSCHFGPL
     TYSCHFGPL
      YSCHFGPLTW
        CHFGPLTWV
                              GSGGGSGTL
                               SGGGSGTLV
                                GGGSGTLVTV
                                 GGSGTLVTV
                                      TLVTVSSEPK
                                       LVTVSSEPK
                                            SSEPKSCDKT
                                            SSEPKSCDK
```

Figure 14. Peptides that are predicted to bind MHC class I molecules.

(SEQ ID NO:1119)

```
QIQGGTYSCHFGPLTWVCKPQGGGSGGGSGTLVTVSSEPKSCDKTHTCPPC
                FGPLTWVCKPQGGGS
                   LTWVCKPQGGGSGGG
                                    SGTLVTVSSEPKSCD
             SCHFGPLTWVCKPQG
                                GGGSGTLVTVSSEPK
                                 GTLVTVSSEPKSCDK
                                    VTVSSEPKS
```

Figure 15. Peptides that are predicted to bind MHC class II molecules.

Advantages: The novel construct, EMP-NfusCG1 described above offers an alternative way of displaying the bioactive peptide EMP-1. The activity of this construct is in the range of rHuEPO and the *in vivo* half-life is similar to that of an IgG. In addition, proposed modifications are expected to, in combination and in addition to the novel features of EMP-NfusCG1, enhance the utility of the EMP-NfusCG1 construct.

It will be clear that the invention can be practiced otherwise than as particularly described in the foregoing description and examples.

Numerous modifications and variations of the present invention are possible in light of the above teachings and, therefore, are within the scope of the present invention

WHAT IS CLAIMED IS:

1. At least one CH1 deleted mimetibody nucleic acid, comprising at least one polynucleotide encoding the amino acid sequence of SEQ ID NO:1112, or a polynucleotide complementary thereto.

2. At least one CH1 deleted mimetibody nucleic acid, comprising at least one polynucleotide encoding the amino acid sequence of SEQ ID NO:1113, or a polynucleotide complementary thereto.

3. At least one CH1 deleted mimetibody nucleic acid, comprising at least one polynucleotide encoding a polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is at least one portion of an N-terminus of an immunoglobulin variable region, Pep is at least one bioactive peptide, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is at least one portion of a C-terminus of an immunoglobulin variable region, pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is at least a portion of an immunoglobulin CH2 constant region, CH3 is at least a portion of an immunoglobulin CH3 constant region, n and m can be an integer between 1 and 10.

4. At least one CH1 deleted mimetibody polypeptide, comprising all of the contiguous amino acids of SEQ ID NO:1112.

5. At least one CH1 deleted mimetibody polypeptide, comprising all of the contiguous amino acids of SEQ ID NO:1113.

6. At least one CH1 deleted mimetibody polypeptide, comprising a polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is QIQ, Pep is at least one bioactive peptide selected from SEQ ID NOS:1-42, Flex comprises GGGS, V2 is GTLVTVSS (SEQ ID NO:1126), pHinge is EPKSCDKTHTCPPCPAPELLGGP (SEQ ID NO:1120), CH2 is SVFLFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVH NAKTKPREEQYNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAK (SEQ ID NO:1121), CH3 is GQPREPQVYTLPPSRDELTKNQVSLTCLVKGFYPSDIAVEWESNGQ PENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGK (SEQ ID NO:1122), and n and m are an integer between 1 and 10.

7. At least one CH1 deleted mimetibody polypeptide, comprising a polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is QIQ, Pep is at least one bioactive peptide selected from SEQ ID NOS:1-42, Flex comprises GGGS, V2 is GTLVTVSS (SEQ ID NO:1126), pHinge is ESKYGPPCPSCPAPEFLGGP (SEQ ID NO:1123), CH2 is SVFLFPPKPKDTLMISRTPEVTCVVVDVSQEDPEVQFNWYVDGVEVHNAKTKPREEQFNSTYR VVSVLTVLHQDWLNGKEYKCKVSNKGLPSSIEKTISKAK (SEQ ID NO:1124), CH3 is GQPREPQVYTLPPSQEEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGS FFLYSRLTVDKSRWQEGNVFSCSVMHEALHNHYTQKSLSLSLGK (SEQ ID NO:1125), and n and m are an integer between 1 and 10.

8. At least one CH1 deleted mimetibody polypeptide, comprising a polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is an N-terminal portion of a human variable region, Pep is at least one bioactive peptide selected from SEQ ID NOS:1-42, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is at least one portion of a C-terminus of an immunoglobulin variable region, pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is SVFLFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVH NAKTKPREEQYNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAK (SEQ ID NO:1121), CH3 is GQPREPQVYTLPPSRDELTKNQVSLTCLVKGFYPSDIAVEWESNGQ PENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGK (SEQ ID NO:1122), and n and m are an integer between 1 and 10.

9. At least one CH1 deleted mimetibody polypeptide, comprising a polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is an N-terminal portion of a human variable region, Pep is at least one bioactive peptide selected from SEQ ID NOS:1-42, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is at least one portion of a C-terminus of an immunoglobulin variable region, pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is SVFLFPPKPKDTLMISRTPEVTCVVVDVSQEDPEVQFNWYVDGVEVHNAKTKPREEQFNSTYR VVSVLTVLHQDWLNGKEYKCKVSNKGLPSSIEKTISKAK (SEQ ID NO:1124), CH3 is GQPREPQVYTLPPSQEEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGS FFLYSRLTVDKSRWQEGNVFSCSVMHEALHNHYTQKSLSLSLGK (SEQ ID NO:1125), and n and m are an integer between 1 and 10.

10. At least one CH1 deleted mimetibody polypeptide, comprising a

polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is QIQ, Pep is at least one bioactive peptide selected from SEQ ID NOS:1-42, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is at least one portion of a C-terminus of an immunoglobulin variable region, pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is at least a portion of an immunoglobulin CH2 constant region, CH3 is at least a portion of an immunoglobulin CH3 constant region, n and m can be an integer between 1 and 10.

11. At least one CH1 deleted mimetibody polypeptide, comprising a polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is at least one portion of an N-terminus of an immunoglobulin variable region, Pep is at least one bioactive peptide, Flex comprises GGGS, V2 is at least one portion of a C-terminus of an immunoglobulin variable region, pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is at least a portion of an immunoglobulin CH2 constant region, CH3 is at least a portion of an immunoglobulin CH3 constant region, n and m can be an integer between 1 and 10.

12. At least one CH1 deleted mimetibody polypeptide, comprising a polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is at least one portion of an N-terminus of an immunoglobulin variable region, Pep is at least one bioactive peptide, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is GTLVTVSS (SEQ ID NO:1126), pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is at least a portion of an immunoglobulin CH2 constant region, CH3 is at least a portion of an immunoglobulin CH3 constant region, n and m can be an integer between 1 and 10.

13. At least one CH1 deleted mimetibody polypeptide, comprising a polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is at least one portion of an N-terminus of an immunoglobulin variable region, Pep is at least one bioactive peptide, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is is at least one portion of a C-terminus of an immunoglobulin variable region, pHinge is EPKSCDKTHTCPPCPAPELLGGP (SEQ ID NO:1120), CH2 is at least a portion of an immunoglobulin CH2 constant region, CH3 is at least a portion of an immunoglobulin CH3 constant region, n and m can be an integer between 1 and 10.

14. At least one CH1 deleted mimetibody polypeptide, comprising a

polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is at least one portion of an N-terminus of an immunoglobulin variable region, Pep is at least one bioactive peptide selected from SEQ ID NOS:43-500, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is at least one portion of a C-terminus of an immunoglobulin variable region, pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is at least a portion of an immunoglobulin CH2 constant region, CH3 is at least a portion of an immunoglobulin CH3 constant region, n and m can be an integer between 1 and 10.

15. At least one CH1 deleted mimetibody polypeptide, comprising a polypeptide according to Formula (I):

(V1(n)-Pep(n)-Flex(n)-V2(n)-pHinge(n)-CH2(n)-CH3(n))(m),

where V1 is at least one portion of an N-terminus of an immunoglobulin variable region, Pep is at least one bioactive peptide selected from SEQ ID NOS:501-1110, Flex is polypeptide that provides structural flexablity by allowing the mimietibody to have alternative orientations and binding properties, V2 is at least one portion of a C-terminus of an immunoglobulin variable region, pHinge is at least a portion of an immunoglobulin variable hinge region, CH2 is at least a portion of an immunoglobulin CH2 constant region, CH3 is at least a portion of an immunoglobulin CH3 constant region, n and m can be an integer between 1 and 10.

16. A(n) CH1 deleted mimetibody nucleic acid or CH1 deleted mimetibody polypeptide according to any of claims 1-15, wherein said polypeptide has at least one activity of at least one Pep polypeptide.

17. A CH1 deleted mimetibody antibody, comprising a monoclonal or polyclonal antibody, fusion protein, or fragment thereof, that specifically binds at least one CH1 deleted mimetibody polypeptide according to any of claims 1-15.

18. A CH1 deleted mimetibody nucleic acid encoding at least one CH1 deleted mimetibody polypeptide or CH1 deleted mimetibody antibody according to any of claim 1-17.

19. A CH1 deleted mimetibody vector comprising at least one isolated nucleic acid according to any of claims 1-3 or encoding, or complementary to such nucleic acid encoding, a CH1 deleted mimetibody according to any of claims 4-15.

20. A CH1 deleted mimetibody host cell comprising an isolated nucleic acid according to claim 18.

21. A CH1 deleted mimetibody host cell according to claim 20, wherein said host cell is at least one selected from COS-1, COS-7, HEK293, BHK21, CHO, BSC-1, Hep G2, 653, SP2/0, 293, NSO, DG44 CHO, CHO K1, HeLa, myeloma, or lymphoma cells, or any derivative,

immortalized or transformed cell thereof.

22. A method for producing at least one CH1 deleted mimetibody polypeptide or CH1 deleted mimetibody antibody, comprising translating a nucleic acid according to claim 18 under conditions in vitro, in vivo or in situ, such that the CH1 deleted mimetibody or antibody is expressed in detectable or recoverable amounts.

23. A composition comprising at least one CH1 deleted mimetibody nucleic acid, CH1 deleted mimetibody polypeptide, or CH1 deleted mimetibody antibody according to any of claims 1-17.

24. A composition according to claim 23, wherein said composition further comprises at least one pharmaceutically acceptable carrier or diluent.

25. A composition according to claim 23, further comprising at least one composition comprising an therapeutically effective amount of at least one compound, composition or polypeptide selected from at least one of a detectable label or reporter, a TNF antagonist, an anti-infective drug, a cardiovascular (CV) system drug, a central nervous system (CNS) drug, an autonomic nervous system (ANS) drug, a respiratory tract drug, a gastrointestinal (GI) tract drug, a hormonal drug, a drug for fluid or electrolyte balance, a hematologic drug, an antineoplactic, an immunomodulation drug, an opthalmic, otic or nasal drug, a topical drug, a nutritional drug, a cytokine, or a cytokine antagonist.

26. A composition according to claim 22, in a form of at least one selected from a liquid, gas, or dry, solution, mixture, suspension, emulsion or colloid, a lyophilized preparation, or a powder.

27. A method for diagnosing or treating a CH1 deleted mimetibody ligand related condition in a cell, tissue, organ or animal, comprising

(a) contacting or administering a composition comprising an effective amount of at least one CH1 deleted mimetibody nucleic acid, polypeptide or antibody according to any of claims 1-17, with, or to, said cell, tissue, organ or animal.

28. A method according to claim 27, wherein said effective amount is 0.001-50 mg of CH1 deleted mimetibody antibody; 0.000001-500 mg of said CH1 deleted mimetibody; or 0.0001-100μg of said CH1 deleted mimetibody nucleic acid per kilogram of said cells, tissue, organ or animal.

29. A method according to claim 27, wherein said contacting or said administrating is by at least one mode selected from parenteral, subcutaneous, intramuscular, intravenous, intrarticular, intrabronchial, intraabdominal, intracapsular, intracartilaginous, intracavitary, intracelial, intracelebellar, intracerebroventricular, intracolic, intracervical, intragastric, intrahepatic, intramyocardial, intraosteal, intrapelvic, intrapericardiac, intraperitoneal, intrapleural, intraprostatic,

intrapulmonary, intrarectal, intrarenal, intraretinal, intraspinal, intrasynovial, intrathoracic, intrauterine, intravesical, intralesional, bolus, vaginal, rectal, buccal, sublingual, intranasal, or transdermal.

30. A method according to claim 27, further comprising administering, prior, concurrently or after said (a) contacting or administering, at least one composition comprising an effective amount of at least one compound or polypeptide selected from at least one of a detectable label or reporter, a TNF antagonist, an anti-infective drug, a cardiovascular (CV) system drug, a central nervous system (CNS) drug, an autonomic nervous system (ANS) drug, a respiratory tract drug, a gastrointestinal (GI) tract drug, a hormonal drug, a drug for fluid or electrolyte balance, a hematologic drug, an antineoplactic, an immunomodulation drug, an opthalmic, otic or nasal drug, a topical drug, a nutritional drug, a cytokine, or a cytokine antagonist.

31. A device, comprising at least one isolated CH1 deleted mimetibody polypeptide, antibody or nucleic acid according to any of claims 1-17, wherein said device is suitable for contacting or administerting said at least one of said CH1 deleted mimetibody polypeptide, antibody or nucleic acid, by at least one mode selected from parenteral, subcutaneous, intramuscular, intravenous, intrarticular, intrabronchial, intraabdominal, intracapsular, intracartilaginous, intracavitary, intracelial, intracelebellar, intracerebroventricular, intracolic, intracervical, intragastric, intrahepatic, intramyocardial, intraosteal, intrapelvic, intrapericardiac, intraperitoneal, intrapleural, intraprostatic, intrapulmonary, intrarectal, intrarenal, intraretinal, intraspinal, intrasynovial, intrathoracic, intrauterine, intravesical, intralesional, bolus, vaginal, rectal, buccal, sublingual, intranasal, or transdermal.

32. An article of manufacture for human pharmaceutical or diagnostic use, comprising packaging material and a container comprising at least one isolated CH1 deleted mimetibody polypeptide, antibody or nucleic acid according to any of claims 1-17.

33. The article of manufacture of claim 17, wherein said container is a component of a parenteral, subcutaneous, intramuscular, intravenous, intrarticular, intrabronchial, intraabdominal, intracapsular, intracartilaginous, intracavitary, intracelial, intracelebellar, intracerebroventricular, intracolic, intracervical, intragastric, intrahepatic, intramyocardial, intraosteal, intrapelvic, intrapericardiac, intraperitoneal, intrapleural, intraprostatic, intrapulmonary, intrarectal, intrarenal, intraretinal, intraspinal, intrasynovial, intrathoracic, intrauterine, intravesical, intralesional, bolus, vaginal, rectal, buccal, sublingual, intranasal, or transdermal delivery device or system.

34. A method for producing at least one isolated CH1 deleted mimetibody polypeptide, antibody or nucleic acid according to any of claims 1-17, comprising providing at least one host cell, transgenic animal, transgenic plant, plant cell capable of expressing in detectable or recoverable amounts said polypeptide, antibody or nucleic acid.

35. At least one CH1 deleted mimetibody polypeptide, antibody or nucleic acid, produced by a method according to claim 34.

36. Any invention described herein.